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**A PLIOCENE FAUNA FROM WESTERN ECUADOR \***

BY HENRY A. PILSBRY<sup>1</sup> AND AXEL A. OLSSON<sup>2</sup>

In recent years, various geological investigations have demonstrated the development of rocks of Pliocene age at many places along the north-western coast of South America as well as in Panama and the Galapagos Islands. The occurrence of marine Pliocene and Pleistocene on certain islands of the Galapagos was shown by Dall and Ochsner.<sup>3</sup> In north-western Peru,<sup>4</sup> Pliocene rocks underlie a large part of the Sechura Desert and extend northward as the highest or oldest of the elevated terrace or tablazo levels (the Mancora Tablazo). The Pliocene fauna of Peru is still incompletely known, as the fossils are generally poorly preserved, but sufficient data is at hand to indicate that the Mancora Tablazo is Pliocene in age and roughly equivalent to the Coquimbo beds of northern Chile.<sup>5</sup> The geological research of Mr. R. A. Terry in Panama has resulted in the discovery of a thick and well-folded section of marine Pliocene and Pleistocene deposits on the Burica Peninsula of southwestern Panama. This

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We are greatly indebted to Dr. O. B. Hopkins, Director of the International Petroleum Company of Toronto, and to Mr. O. C. Wheeler, Chief Geologist, for permission to publish this paper. The collections were made principally by the junior author in the course of visits to Ecuador in 1936, '37 and '38 and he gratefully acknowledges the generous assistance and cooperation received from Mr. O. B. Boggs, who accompanied him on most of his travels in Ecuador, and to Mr. H. R. Haylock.

<sup>1</sup> Curator of Mollusks, The Academy of Natural Sciences of Philadelphia.

<sup>2</sup> Consulting geologist.

<sup>3</sup> Dall and Ochsner, 1928, Tertiary and Pleistocene Mollusca From the Galapagos Islands. Proc. Calif. Acad. Sci., Ser. 4, vol. 17, pp. 89-139, pls. 2-7, 5 text-figures.

<sup>4</sup> Iddings and Olsson, 1928, Geology of Northwest Peru. Bull. Amer. Assoc. Petroleum Geologists, vol. 12, p. 27.

<sup>5</sup> Olsson, 1932, The Peruvian Miocene. Bulls. Amer. Paleontology, vol. 17, no. 28, p. 42.

sedimentary zone continues for an unknown distance northward into southwestern Costa Rica in the region of the Gulf of Dulce.

In western Ecuador, rocks of Pliocene age have now been proved by their fossils to occur in three general areas. A fourth zone is probably found in the extreme northwestern part of the Province of Esmeraldas, extending northward into southwestern Colombia (Narino), but this country is very low and but few exposures are found near the coast. A list of fossils from Uimbi given by Wolf<sup>6</sup> has been regarded as Pliocene by some authors. This collection is perhaps Miocene, as fossiliferous rocks of this age are well exposed along the Rio Santiago of which the Rio Uimbi is a branch. There is little doubt, however, that a large part of the low lands along the coast are underlain by beds of both Pliocene and Pleistocene age.

It is in the Province of Manabi where the Pliocene formations are best exposed and most fossiliferous. The most northerly area in Manabi is found at Jama where the Pliocene belt begins a few miles north of the Rio Jama and extends southward to Cabo Pasados or from approximately 0° 8' South Latitude to 0° 23' South Latitude. These beds appear to be a little older than the Pliocene of Punta Blanca and will be referred to in this paper as the Jama formation. The second Pliocene region is that of southwestern Manabi, beginning at Punta Blanca and extending southward and inland for a few miles, or between 1° 7' South Latitude to about 1° 13' South Latitude. Sheppard<sup>7</sup> was the first to describe the section at Punta Blanca under the name of the Canoa formation, and a collection of fossils from there was studied by Mr. R. Wright Barker. Although these fossils were determined to the genus only, it was recognized that the fauna differed considerably from that of the present day, thereby indicating a Pliocene rather than a Pleistocene age. The name Canoa formation, given to these beds by Sheppard, is perhaps an unfortunate selection, as at Punta Canoa itself and for some distance north of there, the marine Pliocene is absent, the cliffs being formed entirely of Pleistocene deposits. Finally, a third Pliocene zone is found in the lower Guayas valley south of Guayaquil, but the rocks are well-exposed only at the northern end of Puna Island. This southern zone probably continues southward along the coast toward the Peruvian border, but the geology of that region is little known.

At some places in Ecuador the Pliocene beds are overlain by younger deposits of Pleistocene age, and unless their fossils are well understood, or the section carefully studied, the whole series of beds may be easily mistaken for a single stratigraphic unit. The fauna from the lower beds, although having many species of recent mollusks, carries a high percentage of extinct

<sup>6</sup> Wolf, T., 1892, *Geografia y Geologia del Ecuador*. Leipzig, pp. 630-632.

<sup>7</sup> Sheppard, 1930, *The Geology of South-Western Ecuador*. Bull. Amer. Assoc. Petroleum Geologists, vol. 14, pp. 287, 288. Also, 1937, *The Geology of South-Western Ecuador*. Thomas Murby and Co., London, pp. 136-138, fig. 101.

forms some of which are closely related to Miocene species. Where the contact between the Pliocene and Pleistocene deposits has been carefully studied, the line of separation between them is sharp and distinct, showing often as a small unconformity.

#### *Jama formation*

The type exposures of this formation occur along the south side of Jama Bay. It is also excellently developed south of Punta Ballena, especially between this point and Punta Borracho (Punta Venado). The formation extends nearly continuously to Cabo Pasados and for about a mile to the south, but was not recognized to the west of Bahia. To the north of Jama there are occasional patches of Tablazo-like rocks resting with marked unconformity upon older formations of bedded tuffs, cherts and igneous rocks of Eocene age. Another zone of probable Pliocene begins at Pedernales and extends northward along the coast to Surones and along the inner side of the mangrove-swamp region of Cojimies, but no fossils were noted in these beds. The coastal stretch between Punta Borracho and Cabo Pasados has been greatly disturbed by landslides, entire sections of the cliffs having slumped to the beach over a wide zone. Behind this zone of slump, the higher hills in the background show the Pliocene lying with nearly horizontal bedding. At Cabo Pasados the Jama formation may be seen resting upon Miocene with marked unconformity.

A generalized section of the Jama formation between Puerto Jama and Punta Borracho is as follows:

- Zone A. More or less cross-bedded, yellow sands, with lenses of conglomerate containing pebbles of chert, igneous rocks, and small pellets of volcanic ash. Unfossiliferous; thickness about 200 feet.
- Zone B. Fossil zone. Bluish sands, somewhat lignitic in the upper part, nodular in the lower. In the upper part the fossils are mainly beach types such as *Donax*, *Mulinia*, and *Anomalocardia callistoides*. The fossils in the lower part belong to forms more typical of deeper waters with such thin-shelled species as *Labiosa undulata* and *Harvella elegans tucilla*. Thickness about 15 feet.
- Zone C. A hard coquina and often pebbly sandstone forms Punta Jama (Punta Ballena). The upper part is a shell bed filled with *Anomalocardia*. It is overlain by a blue- or green-colored sandy bed, usually barren of fossils and probably of terrestrial origin. In the coquina beds occur specimens of a large *Ostrea* and *Pecten ventricosus*. This layer rises slowly to the south of Punta Jama and at the same time changes to a cross-bedded sandstone. Thickness 4 to 5 feet.
- Zone D. Cross-bedded sands underlain by massive blue sands with only a few fossils. Thickness 15 to 20 feet.
- Zone E. At Punta Borracho are cross-bedded sands and coarse conglomerate. These rocks are bluish to greenish in color and very hard. Thickness 25 feet or more.



Zone F. Very fossiliferous blue sandstones, partly cross-bedded. Base not observed in this section, but at Cabo Pasados the Jama formation rests with marked unconformity upon Lower Miocene sandstones with *Turritella altilira* Conrad and other fossils.

Fossils from the Jama formation listed or described in this paper come from the lower part of Zone B unless otherwise indicated.

#### *Canoa formation*

Between Punto Blanca and extending south along the beach to Punta San José or Punta Canoa are cliffs composed of fossiliferous sands, clays, and beach limestones of Pliocene and Pleistocene age. To the older series or the Pliocene portion, the name Canoa formation was given by Sheppard, and the exposure at Punta Blanca was described as the type section. Fossils from these beds were studied by Barker, and although they were not specifically determined, he correctly assigned to them a Pliocene age. The Pliocene beds begin at Punta Blanca where they may be seen resting with strong unconformity on steeply dipping Upper Oligocene foraminiferal shales and from there they extend south for a distance of about three miles where they disappear by dipping beneath the Upper or Pleistocene series. At Punta Canoa, still farther south, the cliffs are formed entirely of Pleistocene deposits. In some places, as near the mouth of the small dry Quebrada Mangle, the Pliocene beds are greatly slumped, so that in this zone a regular or continuous section cannot be followed. The Pliocene as well as the Pleistocene beds thicken to the south, partly as the result of a normal thinning or overlap to the north and by the introduction of new members. As exposed in this section the Canoa formation has a thickness of about 125 feet grouped in the following manner:

*Recent.* Light-colored, loamy sands, regularly or strongly cross-bedded.

Fossils are *Arca tuberculosa*, *Potamides* and various land shells.

#### *Pleistocene.* (Manta Tablazo)

A. Well-bedded, dull or earth-colored clays, little sand, and barren of fossils. Thickness 20 to 30 feet.

B. Even to cross-bedded beach sands, gray or white in color. At base there is a coarse sand formed of shell fragments containing principally *Pecten* and *Mellita*. Thickness 12 feet.

C. Massive sands, brown in color and not cross-bedded. A small irregular sea-urchin is locally common. At the base is a zone of large Pinnae, along which issues spring water heavily charged with lime. From a distance the contact is seen to be an unconformity, the underlying Pliocene dipping at a slightly steeper angle. Thickness 3 to 4 feet.

#### *Pliocene.* (Canoa formation)

D. Light, gray sandy clays without fossils. Thickness 10 feet.

E. Bluish sandy-clays, sparingly fossiliferous above, more richly so

below. *Pecten ventricosus*, fragments of *Chione*, *Arca*, and *Polinices*. Thickness 8 feet.

F. *Pecten* Zone. Zone of many *Pecten ventricosus* as well as *Ostrea megodon*, *Anomia*, *Placunanomia*, *Panopaea*, *Dosinia grandis*, *Turritella*, *Cidaris*, *Balanus*, and *Coronula*. Thickness 1 to 2 feet.

G. Blue, massive, sandy clay with few, scattered fossils mostly in small fragments. Thickness about 25 feet.

H. *Loripcs* Zone. Very fossiliferous, blue, sandy clays. Many fossils, the most characteristic being *Loripinus sphaerica* Dall and Ochsner. Thickness about 15 feet.

I. *Tagelus* Zone. Very fossiliferous, blue, sandy clays. Between this zone and the above there is no sharp line of separation. Thickness about 12 feet.

J. *Cancellaria* Zone. Massive to well-bedded blue sands and clays. Some of the sands are quite carbonaceous. In the upper part the sands are more or less nodular. The lower 4 feet is a hard ledge forming a shelf or basal layer resting unconformably on the steeply dipping Oligocene shales. This layer is highly fossiliferous, in places riddled by holes formed by burrowing organisms, filled with shell drift. Thickness about 50 feet.

#### SUMMARY

At the present writing, the combined faunas from the Jama and Canoa formations number about 237 species of which 72 species are listed only from the Jama, and 144 only from the Canoa. About 130 species, or approximately 54 per cent, are also recent forms, living along the present coast of Ecuador. Thus about 46 per cent is composed of extinct species, the majority being new species described herein for the first time. Among the new species from the Ecuadorian Pliocene there are a few forms such as *Crenella ecuadoriana*, *Tagelus peruvianus*, *Solecortus broggii*, and *Mactra atacama* which are also recent species from the Ecuadorian and north Peruvian coast, but have previously been overlooked by other collectors. Probably some others of the species believed to be extinct will be discovered in the recent fauna, but such changes will be more or less compensated for by the finding of other new species as the Ecuadorian Pliocene is more thoroughly explored. An interesting element is the presence of several Miocene species previously known only from the Tumbes beds of northern Peru, such as *Arca larkini*, *Harvella elegans tucilla*, *Pecten nelsoni*, *Architectonica sex-linearis*, *Marginella incrassata*, and *Terebra nelsoni*. With the Pliocene fauna described from the Galapagos Islands by Dall and Ochsner, the relations are not so well-marked as might be expected, although one species, *Loripinus sphaerica*, characteristic of Zone H at Punta Blanca, occurs in both localities. With the recently discovered Pliocene of southwestern Panama, still incompletely known, the relationship appears quite close, with *Chione traftoni*, *Macoma* (*Macoploma*) species, *Strombina ecuadoriana*,

*Nassa puntablancensis*, *Strombinophos loripanus*, and *Cymatophos galerus* common to both.

In the following tables the distribution of the mollusks of the Jama and Canoa formations is indicated. The prefix R indicates that the species is also Recent, and the prefix M that it is known in deposits of Miocene age.

		Canoa formation			Jama formation	
		J	I	H	Lower	Upper
R	<i>Porphyrobaphe iostoma bilabrata</i> Pils. . .	×				
	<i>Acteocina puruha</i> new species . . . . .	×		×		
	<i>Terebra (Terebra) elena</i> new species . .				×	
	<i>Terebra (Strioterebrum) armillata shep-</i> <i>pardi</i> new subspecies . . . . .	×				
M	<i>Terebra (Strioterebrum) nelsoni</i> Hanna & Israelsky . . . . .	×				
R	<i>Terebra (Strioterebrum) cracilenta</i> Li . .				×	
	<i>Terebra (Strioterebrum) blanca</i> new species . . . . .	×				
	<i>Terebra (Strioterebrum) manta</i> new species . . . . .			×		
	<i>Terebra (Strioterebrum) loja</i> new species	×				
	<i>Terebra (Strioterebrum) cuenca</i> new species . . . . .				×	
	<i>Terebra (Strioterebrum) tumaca</i> new species . . . . .				×	
R	<i>Conus tornatus</i> Brod. . . . .	×	×			
R	<i>Conus monilifer</i> Brod. . . . .	×				
R	<i>Conus regularis</i> Sby. . . . .				×	
R	<i>Conus pyriformis</i> Reeve . . . . .				×	
M	<i>Conus cacuminatus</i> Spieker . . . . .	×			×	
	<i>Clathrodrillia noventa</i> new species . . . .	×				
	<i>Clathrodrillia woodringi</i> new species . . .			×		
R	<i>Clathrodrillia resina</i> Dall . . . . .	×				
R	<i>Elaeocyma aeolia</i> Dall . . . . .			×		
	<i>Crassispira guayana</i> new species . . . . .				×	
	<i>Nannodiella meridionalis</i> new species . .			×		
	<i>Nannodiella</i> species undet. . . . .	×				
	<i>Mangelia ecuadoriana</i> new species . . . .			×		
	<i>Mangelia heptapleura</i> new species . . . .	×				
	<i>Mangelia hesperia</i> new species . . . . .	×				
R	<i>Cancellaria (Cancellaria) ventricosa</i> Hinds . . . . .				×	
R	<i>Cancellaria (Cancellaria) decussata</i> Sby.	×		×		
R	<i>Cancellaria (Cancellaria) urceolata</i> Hinds	×				
RM	<i>Cancellaria (Cancellaria) obesa schu-</i> <i>cherti</i> Olsson . . . . .	×		×		
	<i>Cancellaria (Cancellaria) yolandia</i> new species . . . . .				×	
	<i>Cancellaria (Cancellaria) jipijana</i> new species . . . . .	×		×		
	<i>Cancellaria (Cancellaria) dolioides</i> new species . . . . .	×				

		Canoa formation			Jama formation	
		J	I	H	Lower	Upper
	<i>Cancellaria (Cancellaria) cominella</i> new species .....	X				
	<i>Cancellaria (Eucha) pacifica</i> new species .....	X				
	<i>Cancellaria (Euchia) harpiiformis</i> new species .....				X	
R	<i>Cancellaria (Euchia) cassidiformis</i> new species .....	X				
R	<i>Cancellaria (Euchia) cremata</i> Hinds ...	X				
R	<i>Cancellaria (Peruchia) solida</i> Sby. ....				X	
R	<i>Cancellaria (Peruchia) bulbulus</i> Sby. ...				X	
R	<i>Cancellaria (Ovilia) cumingiana</i> Petit ..		X			
	<i>Cancellaria (Tribia) bahia</i> new species ..			X		
	<i>Cancellaria (Narona) pajana</i> new species ..	X				
	<i>Trigonostoma ecuadoriana</i> new species..	X				
R	<i>Oliva polpasta</i> Duclos .....	X				
R	<i>Oliva kaleontina</i> Duclos ..	X	X			
R	<i>Oliva angulata</i> Lam. ....				X	
R	<i>Oliva spicata</i> Roeding .....				X	
R	<i>Olivella gracilis</i> Brod. & Sby. ....			X		
R	<i>Olivella semistriata</i> Gray .....				X	
M	<i>Marginella incrassata</i> Nelson ..	X	X	X		
R	<i>Marginella minor</i> C. B. Ad. ...	X	X	X		
	<i>Marginella</i> species undet. ....	X				
	<i>Mitra gigantea polystira</i> new subspecies ..	X				
R	<i>Mitra swainsoni</i> Brod. ....	X				
R	<i>Fusinus panamensis</i> Dall .....	X				
	<i>Hanetia ecuadorensis</i> new species ...				X	
	<i>Hanetia cymioides</i> new species .....				X	
R	<i>Hanetia fusiformis</i> Blainville ....	X				
	<i>Hanetia boggsi</i> new species .....	X			X	
	<i>Hindsia wheeleri</i> new species ....			X		
	<i>Nassa palta</i> new species .....	X				
	<i>Nassa cara</i> new species .....	X				
	<i>Nassa pacis</i> new species .....	X				
	<i>Nassa tinosa</i> new species .....				X	
	<i>Nassa (Arcularia) puntablancoensis</i> new species .....	X			X	
	<i>Nassa (Perunassa) ecuadoriana</i> new species .....	X	X	X		
	<i>Cymatophos galerus</i> new species ....				X	
R	<i>Phos cocosensis</i> Dall .....					X
R	<i>Phos</i> cf. <i>gaudens</i> Hinds .....				X	
R	<i>Northia northiae</i> Gray .....				X	
R	<i>Metula amosi</i> Vanatta .....				X	
	<i>Tritiaria (?) ecuadoriana</i> new species ..				X	
R	<i>Strombina lanceolata</i> Sby. ....	X	X			
R	<i>Strombina recurva</i> Sby. ....				X	
R	<i>Strombina gibberula</i> Sby. ....	X	X	X		
	<i>Strombina ecuadoriana</i> new species ....				X	

		Canoa formation			Jama formation	
		J	I	H	Lower	Upper
R	<i>Bifurcium bifurcium</i> Fischer .....					×
	<i>Strombinophos loripanus</i> new species ..			×		
	<i>Aesopus polylophus</i> new species .....	×				
	<i>Aesopus (Glyptaesopus) perornatus</i> new species .....	×			×	
R	<i>Phyllonotus brassica</i> Lam. ....				×	
R	<i>Eupleura muriciformis</i> Brod. ....	×			×	
	<i>Epitonium (Ferminoscala) eleutherium</i> new species .....			×		
	<i>Epitonium (Ferminoscala) manabianum</i> new species .....	×		×		
	<i>Epitonium (Spiniscala) loripanu</i> new species .....			×		
R	<i>Strombiformis paria</i> Bartsch .....			×		
R	<i>Strombiformis inca</i> Bartsch .....			×		
R	<i>Niso imbricata</i> Sby. ....	×				
R	<i>Pyramidella (Longchaeus) elenensis</i> Bartsch .....		×			
	<i>Turbonilla (Mormula) loripana</i> new species .....			×		
	<i>Bursa nana</i> Sby. ....				×	
	<i>Bursa nana jamaicensis</i> new subspecies ..				×	
R	<i>Bursa ventricosa</i> Brod. ....	×				
R	<i>Cymatium wiegmanni</i> Anton .....	×				
R	<i>Distorsio decussatus</i> Val. ....	×			×	
R	<i>Semicassis centiquadratus</i> Val. ....	×				
R	<i>Semicassis centiquadratus</i> var. ....				×	
R	<i>Malea ringens</i> Swainson .....				×	
R	<i>Ficus ventricosus</i> Sby. ....	×			×	
	<i>Cypraea cayapa</i> new species .....				×	
R	<i>Cerithium stercusmuscarum</i> Val. ....		×		×	
	<i>Turritella pasada</i> new species .....				×	×
R	<i>Turritella broderipiana</i> d'Orb. ....	×				
R	<i>Turritella goniostruma</i> Val. ....	×				
	<i>Caecum (Quadrulata) campe</i> new species ..	×	×			
	<i>Onoba fortis</i> new species .....	×				
M	<i>Architectonica sextilinearis</i> Nelson .....				×	
R	<i>Architectonica nobilis</i> Roeding .....	×			×	
R	<i>Crucibulum (Crucibulum) hispidum</i> Brod. ....	×				
M	<i>Crucibulum (Dispotaea) inerme</i> Nelson ..	×				
R	<i>Crucibulum (Dispotaea) imbricatum</i> Brod. ....	×			×	
	<i>Crucibulum alloglyptum</i> new species ....	×				
	<i>Crepidula</i> species undet. ....	×			×	
R	<i>Natica broderipiana</i> Recluz .....	×	×	×	×	
R	<i>Natica elenae</i> Recluz .....	×		×		
R	<i>Natica marochiensis</i> Gmel. ....				×	
R	<i>Natica unifasciata</i> Lam. ....	×				

		Canoa formation			Jama formation	
		J	I	H	Lower	Upper
R	<i>Polinices</i> species undet. ....	×	×			
R	<i>Polinices panamensis</i> Recluz .....	×	×		×	
R	<i>Polinices rapulum</i> Reeve .....				×	
R	<i>Turbo saxosus</i> Wood .....		×			
R	<i>Calliostoma nonurum</i> new species .....	×				
R	<i>Tvinostoma ecuadoriana</i> new species ...			×		
	<i>Pseudorotella lens</i> new species .....	×				
	<i>Circulus occidentalis</i> new species .....	×				
	<i>Systellomphalus perornatus</i> new species .	×				
R	<i>Dentalium</i> ( <i>Tesseracme</i> ) <i>tesseragonum</i> Sby. ....		×	×		
	<i>Cadulus</i> ( <i>Polyschides</i> ) <i>quitus</i> new species	×				
	<i>Cadulus</i> ( <i>Gadilopsis</i> ) <i>leptodoma</i> new species .....	×				
R	<i>Nucula declivis</i> Hinds .....	×	×	×		
R	<i>Nucula exigua</i> Sby. ....	×		×		
	<i>Nucula</i> species undet. ....			×		
R	<i>Nuculana gibbosa</i> Sby. ....	×	×	×		
R	<i>Nuculana eburnea</i> Sby. ....		×	×		
R	<i>Nuculana elenensis pyriformis</i> Hanley ..	×	×	×		
R	<i>Barbatia</i> ( <i>Acar</i> ) <i>gradata</i> Brod. & Sby. ..	×				
M	<i>Noctia reversa peruviana</i> new subspecies				×	
R	<i>Noctia olssoni</i> Shelton & Maury .....					×
R	<i>Arca</i> ( <i>Scapharca</i> ) <i>concinna</i> Sby. ....	×	×	×		
R	<i>Arca</i> ( <i>Scapharca</i> ) <i>obesa</i> Sby. ....				×	
	<i>Arca</i> ( <i>Scapharca</i> ) <i>hopkinsi</i> new species ..	×				
	<i>Arca</i> ( <i>Scapharca</i> ) <i>wheeleri</i> new species ..	×				
	<i>Arca</i> ( <i>Scapharca</i> ) <i>ecuadoriana</i> new species	×				
M	<i>Arca</i> ( <i>Cunearca</i> ) <i>zorritensis</i> Spieker ....				×	
R	<i>Arca</i> ( <i>Cunearca</i> ) <i>nux</i> Sby. ....	×				
R	<i>Arca</i> ( <i>Cunearca</i> ) <i>aequatorialis</i> d'Orb. ...				×	
R	<i>Arca</i> ( <i>Cunearca</i> ) <i>labiata</i> Sby. ....	×				
	<i>Arca</i> ( <i>Cunearca</i> ) <i>esmeralda</i> new species .	×				
R	<i>Arca</i> ( <i>Argina</i> ) <i>brevifrons</i> Sby. ....				×	
M	<i>Arca</i> ( <i>Larkinia</i> ) <i>larkini</i> Nelson .....	×	×			
R	<i>Glycymeris inaequalis</i> Sby. ....	×				
R	<i>Glycymeris maculata</i> Brod. ....	×				
	<i>Glycymeris canoa</i> new species .....	×				
R	<i>Pinna</i> species undet. ....	×				
R	<i>Ostrea megodon</i> Hanley .....	×			×	
R	<i>Plicatula dubia</i> Hanley .....	×				
R	<i>Pecten ventricosus</i> Sby. ....		×	×	×	
R	<i>Pecten tumbezensis</i> d'Orb. ....					×
M	<i>Pecten nelsoni</i> Olsson .....				×	
R	<i>Pecten</i> ( <i>Janira</i> ) <i>sericeus</i> Hinds .....	×	×			
R	<i>Crenella ecuadoriana</i> new species .....	×				
R	<i>Anomia peruviana</i> d'Orb. ....	×	×	×	×	
R	<i>Placunanomia cumingi</i> Brod. ....	×		×	×	

		Canoa formation			Jama formation	
		J	I	H	Lower	Upper
R	<i>Periploma planiuscula</i> Sby. ....					×
M	<i>Eucrassatella gibbosa tucilla</i> new subspecies .....				×	
R	<i>Crassinella pacifica</i> C. B. Ad. ....	×				
	<i>Crassinella clementia</i> new species .....	×				
	<i>Crassinella haylocki</i> new species .....	×				
	<i>Loripinus sphaerica</i> Dall & Ochsner ....			×		
R	<i>Lucina (Bellucina) cancellaris</i> Phil. ....	×				
	<i>Lucina (Parvilucina) callosana</i> new species .....	×				
R	<i>Lucina (Luciniscia) liana</i> Pilsbry .....			×		
	<i>Lucina (Luciniscia) fausta</i> new species ..	×		×		
R	<i>Divaricella lucasana</i> Dall & Ochsner ....	×				
	<i>Diplodonta</i> species undet. ....	×				
	<i>Myrella</i> species undet. ....	×				
	<i>Bornia</i> species 1 .....	×				
	<i>Bornia</i> species 2 .....	×				
	<i>Cardium (Trachycardium) ballenium</i> new species .....				×	
	<i>Cardium (Trigoniocardia) cabopasadium</i> new species .....					×
M	<i>Cardium (Trigoniocardia) spiekeri</i> Hanna & Isrealisky .....				×	
R	<i>Cardium (Trigoniocardia) obovale</i> Sby. .	×	×			
R	<i>Cardium (Trigoniocardia) graniferum</i> Brod. & Sby. ....		×			
R	<i>Cardium (Mexicardia) procerum</i> Sby. .					
R	<i>Laevicardium elenensis</i> Sby. ....		×	×		
	<i>Laevicardium pederalense</i> new species .				×	
M	<i>Dosinia grandis</i> Nelson .....	×	×	×		
R	<i>Tivela byronensis</i> Gray .....					×
R	<i>Macrocallista squalida</i> Sby. ....	×				
R	<i>Pitar affinis</i> Brod. ....		×	×		
	<i>Pitar salanga</i> new species .....				×	
	<i>Chione (Chionopsis) traftoni</i> new species	×				
	<i>Chione (Chionopsis) manabia</i> new species	×				
	<i>Chione (Chionopsis) venadoensis</i> new species .....					×
	<i>Chione (Chionopsis) jamaniana</i> new species .....				×	
R	<i>Chione (Lirophora) mariae</i> d'Orb. ....	×	×	×		
R	<i>Chione (Lirophora) kelletti</i> Hinds ....	×				
	<i>Chione (Lirophora) gorgona</i> new species				×	
	<i>Anomalocardia callistoides</i> new species .				×	×
	<i>Cyclinella galera</i> new species .....				×	
R	<i>Cyclinella subquadrata</i> Hanley .....	×				
R	<i>Clementia (Egesta) solida</i> Dall .....				×	
R	<i>Tellina (Eurytellina) prora</i> Hanley ....				×	
	<i>Tellina (Eurytellina) ecuadoriana</i> new species .....			×		

		Canoa formation			Jama formation	
		J	I	H	Lower	Upper
	<i>Tellina (Eurytellina) laplata</i> new species	×	×	×		
R	<i>Tellina (Eurytellina) panamanensis</i> Li ..			×	×	
	<i>Tellina (Macaliopsis) aequizonata</i> new species .....				×	
R	<i>Tellina (Macaliopsis) lyrice</i> Pilsbry & Lowe .....	×				
RM	<i>Tellina (Macaliopsis) crystallina</i> Woods .....		×			
RM	<i>Tellina (Angulus) cf. felix</i> Hanley .....		×	×		
R	<i>Tellina (Quadrans) cognata</i> C. B. Ad. ..					×
R	<i>Macoma plebeia</i> Hanley .....				×	
R	<i>Macoma grandis</i> Hanley .....		×	×		
R	<i>Macoma lamproleuca</i> Pilsbry & Lowe ..		×	×		
	<i>Macoma (Cymatoica)</i> species undet. ..	×				
R	<i>Macoma (Macoploma) ecuadoriana</i> new species .....		×	×		
R	<i>Apolymetis excavata</i> Sby. ....			×		
R	<i>Semele laevis</i> Sby. ....				×	
	<i>Semele jaramija</i> new species .....	×				
R	<i>Tagelus (Mesopleura) peruvianus</i> new species .....		×			
R	<i>Solecurtus brogii</i> new species .....				×	
R	<i>Sanguinolaria tellinoides</i> C. B. Ad. ....					×
R	<i>Donax dentiferus</i> Hanley .....					×
R	<i>Mactra (Mactrella) alata</i> Spengler ....		×		×	
R	<i>Mactra (Micromactra) atacama</i> new species .....				×	
R	<i>Mulinia pallida</i> Brod. & Sby. ....					×
	<i>Mulinia camina</i> new species .....					×
R	<i>Labiosa undulata</i> Gould .....				×	
M	<i>Harvella elegans tucilla</i> Olsson .....				×	
	<i>Corbula ecuabula</i> new species .....	×				
R	<i>Corbula ovulata</i> Sby. ....				×	
R	<i>Corbula biradiata</i> Sby. ....	×				
R	<i>Corbula nasuta</i> Sby. ....	×				
M	<i>Panopaea cf. coquimbensis</i> d'Orb. ....	×	×			

### The Pliocene of Puna Island

Puna Island, situated at the mouth of the Guayas River about 35 miles south of Guayaquil, was briefly visited by Mr. O. D. Boggs and the junior author in the early part of 1937. Contrasting strongly with the extensive tidal and mangrove swamp topography of the lower Guayas, Puna Island is moderately rugged, affording dry land suitable for settlement and agricultural pursuits. At the northern end of the island there are low cliffs or exposures of poorly consolidated sands, and clays interbedded with masses of pebbly conglomerates. Near the village of Puna itself the rocks are practically barren of organic remains, but they become richly fossiliferous about a quarter mile north of Punta Espanol, the fossils occurring in a



rusty-colored, silty sand containing much lignitic debris. Some of the beds are cross-bedded, but the regional dip of the formation as a whole is low. The fossils are generally fragmentary, water-worn or deeply eaten by burrowing marine organisms. They belong mainly to shallow-water and beach types. Because of the presence of certain extinct species, the beds are believed to be of Pliocene rather than Pleistocene age. The following species have been collected, but more thorough exploration may be expected to increase greatly the list.

<i>Natica unifasciata</i> Lam.	<i>Arca emarginata</i> Sby.
<i>Natica catenata</i> Phil.	<i>Noctia reversa magna</i> MacNeil
<i>Polinices rapulum limi</i> Pils.	<i>Anomia peruviana</i> d'Orb.
<i>Turritella gonostoma</i> Val.	<i>Cardium procerum</i> Sby.
<i>Crepidula</i> species	<i>Mulinia guayasensis</i> new species
<i>Cantharus elegans</i> Gray	<i>Donax punaensis</i> new species
<i>Oliva undatella</i> Lam.	<i>Pecten nelsoni</i> Olsson
<i>Cancellaria bulbulus</i> Sby.	<i>Pinna</i> species
<i>Cancellaria corrugata</i> Hinds	<i>Ostrea</i> species
<i>Arca</i> cf. <i>zorritensis</i> Spicker	

*Pleistocene fossils from Punta Canoa*

The following is a list of fossils collected in the Pleistocene deposits overlying the Pliocene beds represented by the Canoa formation between the mouth of Quebrada Pila and Punta Canoa. They are mentioned in order to illustrate the general characters of the Pleistocene fauna and the marked differences between it and that of the Pliocene beds. This Pleistocene fauna is practically identical with that living along the present coast of Ecuador in the same region, all the shells belonging to common beach species.

<i>Arca tuberculosa</i> Sby.	<i>Dosinia ponderosa</i> Gray
<i>Glycymeris inaequalis</i> Sby.	<i>Macrocallista aurantiaca</i> Sby.
<i>Glycymeris maculata</i> Brod.	<i>Antigona multicostata</i> Sby.
<i>Ostrea prismatica</i> Gray	<i>Chione subrostrata</i> Lam.
<i>Pecten dentatus</i> Sby.	<i>Mulinia byronensis</i> Gray
<i>Pecten subnodosus</i> Sby.	<i>Labiosa undulata</i> Gould
<i>Pecten ventricosus</i> Sby.	<i>Oliva angulata</i> Lam.
<i>Venericardia cuvieri</i> Brod.	<i>Strombus gracilior</i> Gray
<i>Cardium senticosum</i> Sby.	<i>Turritella gonostoma</i> Val.
<i>Cardium procerum</i> Sby.	<i>Maleu ringens</i> Swains.
<i>Cardium magnificum</i> Deshayes	

## SYSTEMATIC LIST OF SPECIES

## GASTROPODA

## BULIMULIDAE

***Porphyrobaphe iostoma bilabrata*** Pilsbry

Plate 8, fig. 9.

The single example has a shorter spire than recent shells, but it has been somewhat "telescoped," the width of the antepenult whorl thereby much reduced. Otherwise it agrees well with the modern form.

Length 53.5 mm.

*Occurrence*.—Canoa formation, Punta Blanca.

## ACTEOCINIDAE

***Acteocina puruha*** new species

Plate 8, fig. 1.

Shell relatively large, cylindrical, slightly wider just below the middle while the shoulder or zone just below the suture is a little narrowed or appressed; sutures deeply channelled; whorls about 4, with a small, projecting nucleus; surface smooth with faint, longitudinal lines of growth and exceedingly faint spirals visible on some parts of the whorl; outer lip thin, widely rounded; inner lip with a parietal callus, the columella concave, with a strong, oblique basal fold merging into the basal lip.

Length 7.5 mm., diameter 3 mm. Type.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13684.

## TEREBRIDAE

***Terebra (Terebra) elena*** new species

Plate 1, figs. 1, 9.

Shell large, robust, solid; whorls numerous, about 14 preserved on the holotype, apex lost; embryonic sculpture similar to that of *T. robusta* is tripartite, the lower third being a concave band which, unlike that of *T. robusta*, persists as a deep impressed zone throughout life, the coiling following along its lower edge; the mature sculpture is otherwise smooth, except for the sinuous lines of growth; beak of moderate length, strongly twisted and with a strong keel at its end; aperture semielliptical with a sinuated outer lip and a thin spread of callus on the inner lip.

Length 120 mm. (imperfect), diameter 25 mm. Type.

This species is closely related to the recent *T. robusta* Hinds but is distinguished by the persisting concave band which lies just above the lower suture on the whorls of the spire and continues about the middle of the body-whorl.

*Occurrence*.—Jama formation, Puerto Jama. Type A.N.S.P. 13634.

***Terebra (Strioterebrum) armillata sheppardi*** new subspecies

Plate 1, fig. 7.

Shell of moderate size, with numerous whorls, the taper of the spire being rather rapid; nucleus and early spire-whorls very small; on the later whorls the sculpture consists of spirals and riblets, and a strongly ribbed or noded sutural fasciolar band; the riblets are generally weak or absent from

the zone adjacent to the sutural fasciole, strengthening below as they cross the periphery of the last whorl; the spirals are generally smoothish, irregular, flattened cords, feebly noded by the riblets and separated by narrow grooves. On whorls of the spire there are 3 such cords between sutural fasciole and the suture below. Base with the cords much smaller, about 6 below the periphery. Columella with 2 low folds.

Length 45 mm., diameter 11.8 mm. Type.

Length 53.5 mm., diameter 12 mm.

*Terebra armillata* Hinds is a fairly common species along the west coast of Ecuador and northern Peru. It differs from the fossil in being usually smaller, the zone adjacent to the sutural fasciole is more or less constricted and the riblets become strong, node-like as they cross the periphery of the whorl, and the spiral cords are far more numerous.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13631.

***Terebra (Strioterebrum) nelsoni*** Hanna & Israelsky Plate 1, figs. 2, 3.

*Myurella tuberosa* Nelson, 1870, Trans. Conn. Acad. Sci., vol. 2, p. 193 (not *T. tuberosa* Hinds, 1843).

*Terebra tuberosa* Spieker, 1922, Johns Hopkins University, Studies in Geology, no. 3, p. 36, pl. 1, fig. 2.

*Terebra nelsoni* Hanna and Israelsky, 1925, Proc. Calif. Acad. Sci., Ser. 4, vol. 14, p. 55.

*Terebra nelsoni* Olsson, 1932, Bulls. Amer. Paleontology, vol. 19, no. 68, p. 149.

The commonest *Terebra* at Punta Blanca is a species here identified with *T. nelsoni* Hanna and Israelsky, originally described as *T. tuberosa* Nelson from the Upper Miocene of northern Peru. Dr. C. O. Dunbar kindly loaned to us the holotype of *T. tuberosa* (Pl. 1, fig. 3), preserved in the Peabody Museum, Yale University. It is an immature shell of about 8 whorls, with the general form and sculpturing characteristic of our specimens from Punta Blanca. Some specimens seem to approach the *Terebra armillata sheppardi* but the species is generally larger, more slender, the fasciolar band is narrower, with more numerous riblets and stronger spirals. The columella is provided with 2 folds.

Length of figured specimen 61 mm.

*Occurrence*.—Canoa formation, Punta Blanca.

***Terebra (Strioterebrum) cracilentia*** Li

*Terebra cracilentia* Li, 1930, Bull. Geol. Soc. China, vol. 9, no. 3, pl. 274, pl. 8, fig. 67.

*Terebra cracilentia* Pilsbry, 1931, Proc. Acad. Nat. Sci. Phila., vol. 83, pp. 434, 439, text-fig. 1, 1a, 2.

Our fossils from Puerto Jama are somewhat larger than typical *cracilentia* from Panama and have usually a finer sculpture. The species is known to be quite variable and one of our shells is very similar to Panamanian specimens. The anterior canal is rather long, twisted, and carries 2 moderately strong columellar folds.

*Occurrence*.—Jama formation, Puerto Jama.

**Terebra (Strioterebrum) blanca** new species

Plate 1, figs. 4, 5.

Shell acute-acuminate, the taper rather rapid; whorls numerous, about  $11\frac{1}{2}$  preserved on the holotype, straight to slightly concave in profile; each spire-whorl is rather wide, with a noticeably inclined suture; sutural fasciole pronounced and strongly noded although the ribbing elsewhere on the shell is weak; below the sutural fasciole the face of the whorl has 5 or 6, flattened, unequal spiral bands, the lowest band, next to the suture, a little noded and becoming more strongly so as it emerges from the suture and forms the periphery of the last whorl; on the base of the last whorl there are 6 additional, unequal spirals between the periphery and the siphonal fasciolar keel; the ribbing is weak to subobsolete, sinuated in the middle in harmony with the lines of growth; pillar long, straight, the beak a little twisted at the end; no columellar folds.

Length 56 mm., diameter 12.5 mm. Type.

Length 44 mm., diameter 10 mm.

We have 3 specimens of this very distinct species, recognized by its smooth pillar, straight canal, and elegant sculpture.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13632.

**Terebra (Strioterebrum) manta** new species

Plate 1, fig. 8.

Shell small, with 9 or more (apex lost on type), irregularly convex, or swollen whorls between irregular, somewhat denticulate sutures; sutural fasciole about one-fourth the width of each spire-whorl, strongly sculptured by the upper ends of the ribs; axial sculpture of rather strong, curved ribs; which number from 12 to 15, and are regularly spaced on most whorls but may become somewhat crowded on the last; spiral sculpture lacking on the sutural fasciole; there are about 6 spiral cords on the whorls of the spire, the lower with wider grooves between; on the last whorl there are 6 spirals to about the middle of the whorl where there is a marked change to many smaller spirals across the base to the siphonal fasciole; base of last whorl rounded, the anterior canal of moderate length, twisted; the columella unarmed; aperture subelliptical.

Length 9.5 mm., diameter 4.25 mm.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13630.

**Terebra (Strioterebrum) loja** new species

Plate 1, fig. 10.

Shell of medium size, robust; nucleus unknown; postnuclear whorls numerous, 10 or more (the apex lost on specimen), acuminate, the early whorls tapering more rapidly; sutural band strong, about a quarter of the width of the whorl, and bordered below by a strong groove; the axial sculpture consists of fairly strong, sinuous riblets which commence on the base and extend upward across the face of the whorl and sutural fasciole to the upper suture; these ribs number 10 on the last whorl, they are crossed by spiral cords which on the penultimate whorl are arranged as follows: the lower 6 are even and close, separated merely by grooves, then follows a stronger spiral above bordered on each side by a groove of the same width as the cord itself; on the last whorl the spiral sculpture is similar, with about 11 spirals below the sutural fasciole to about the center of the base, with about 5 more below, which sometimes tend to be double; pillar

smooth, or with 2 faint folds, the anterior beak twisted with a revolving keel outside, bounding the siphonal fasciole.

Length (as broken) 37 mm., diameter 10 mm. Type.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13627.

***Terebra (Strioterebrum) cuenca* new species**

Plate I, fig. 11.

Shell of medium size, robust, acuminate; whorls numerous, about 13 preserved on the holotype (apex missing), taper uniform; sutural band about one-third of the width of the spire-whorls, defined below by a deep, narrow groove, at least equal to the suture in depth; sculpture of spirals and riblets, the former weak or smoothish in appearance; the riblets are strongest on the earlier spire-whorls where they extend from the lower suture across the face of the whorl and sutural fasciole to the upper suture, forming a series of little, arcuate, wave-like folds; they are slightly constricted by the lower groove of the sutural fasciole and leave a series of deep, puncture-like indentations in the intercostal depressions; on the later whorls the riblets increase greatly in number, become crowded and occasionally irregular, there being about 28 or 29 on the last turn; these ribs begin in the siphonal fasciole and extend upward in a sinuous fashion to the sutural fasciole above; the spirals are smoothish, irregular bands, few in number on the early spire-whorls, more numerous and stronger on the later turns; pillar humped, smooth, no folds; beak and anterior canal twisted.

Length 41 mm., diameter 9.5 mm.

The main distinguishing characters of this species are its dissimilar sculpture of the earlier and later whorls as well as the punctate feature of the groove bordering the sutural fasciole on the earlier whorls.

*Occurrence*.—Jama formation, Punta Venada. Type A.N.S.P. 13633.

***Terebra (Strioterebrum) tumaca* new species**

Plate I, fig. 6.

Shell small, short, acuminate, solid; whorls 7 or more, the holotype not perfect; strongly sculptured, the sutural fasciole strong, about one-third of the width of the whorl, bordered below by a deep groove; the sculpture is strong and persistent; the axial sculpture consists of strong, straight riblets, dislocated by the groove bordering the sutural fasciole, so that the sculpture of the sutural fasciole appears knobbed or noded; these riblets number about 26 on the last whorl; there are 3 spiral cords on the whorls of the spire below the sutural fasciole; these spirals are of nearly equal strength, the upper 2 being more widely separated; on the last whorl there are 2 strong spirals above, with about 12 smaller ones below; base of whorl short, contracted, with a strong, encircling keel, which entering the aperture, becomes the upper or posterior fold on the columella; growth-lines a little sinuous, the aperture short-ovate; pillar strongly twisted, the columella bearing 2 strong folds.

Length 21 mm., diameter 7 mm. Type.

Our only specimen is probably not mature, but the species will be easily recognized by its strong, regular sculpture, short, strongly twisted canal and two columellar folds.

*Occurrence*.—Jama formation, Jama. Type A.N.S.P. 13628.

## CONIDAE

**Conus tornatus** Broderip

Our fossils agree exactly with specimens from the beach.

*Occurrence*.—Canoa formation, Punta Blanca.

**Conus monilifer** Broderip

This species is similar in form to *Conus tornatus* but can be distinguished by its series of fine revolving lines just below the shoulder angle. In *tornatus* this area of the surface is smooth.

*Occurrence*.—Jama formation, Puerto Jama. Canoa formation, Punta Blanca.

**Conus regularis** Sowerby

The fossils are much larger and coarser than the average recent specimens of this species.

*Occurrence*.—Jama formation, Puerto Jama.

**Conus pyriformis** Reeve

These specimens are quite large with the height of the spire varying from low and flat to moderately elevated with an elevated, projecting nucleus. Recent specimens of *pyriformis* show a similar or even greater range of variation.

*Occurrence*.—Jama formation, Puerto Jama.

**Conus cacuminatus** Spieker

*Conus* sp. ind. B. Nelson, 1870, Trans. Conn. Acad. Sci., vol. 2, p. 194.

*Conus cacuminatus* Spieker, 1922, Johns Hopkins University, Studies in Geology, no. 3, p. 40, pl. 1, fig. 5.

*Conus cacuminatus* Woodring, 1928, Carnegie Inst. Washington, Publ., no. 385, p. 209

*Conus cacuminatus* Olsson, 1932, Bulls. Amer. Paleontology, vol. 19, p. 155.

This species was described by Spieker from northern Peru, where it occurs in the Upper Miocene or Tumbes formation. It is represented by a number of specimens from Punta Blanca, but it is still unknown in the recent fauna. It is distinguished by the excavated surface of the spire whorls. The earlier whorls have a ribbed or nodose shoulder and a sculpture of fairly strong spiral threads which quickly become fine and subobsolete, and on the later portions of the shell the surface is nearly smooth. One of our specimens shows a series of faintly waved, brown lines, indicating a color pattern somewhat similar to that of *Conus virgatus* Reeve.

*Occurrence*.—Canoa formation, Punta Blanca.

## TURBITIDAE

**Clathrodrillia noventa** new species

Plate 2, fig 5

The shell is fusiform, with the spire a little longer than the aperture, solid; whorls 8+, with the embryonic whorls missing; the surface is nearly smooth except for a series of low ribs, prominent at the shoulder, fading

out below it, and developed only on the spire-whorls; these ribs number about 9 to the turn, weaken on the penultimate whorl, and are entirely missing from the last; the surface is nearly smooth or faintly marked with very minute spirals except on the anterior half of the last whorl, where the spirals are fairly strong; anal fasciole about one-third the width of the whorl, a little concave, a faint spiral impression below it on the last turn; the anal sinus is moderately deep, narrow, below the principal concavity of the fasciole. Aperture narrow, the outer lip broken away; columella is long, straight, smooth, covered with a moderate thickness of callus.

Length 60 mm., diameter 19.5 mm., aperture 28 mm. Type.

A nearly smooth species represented by the single type specimen.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13636.

#### ***Elaeocyma aeolia* Dall**

*Elaeocyma aeolia* Dall, 1919, Proc. U. S. Nat. Museum, vol. 56, p. 11, pl. 3, fig. 1.

We have one specimen from the *Loripes* or Zone H of the Canoa formation below Punta Blanca.

#### **?*Clathrodrillia resina* Dall**

Plate 2, fig. 1.

*Turris (Surcula) resina* Dall, 1908, Bull. Mus. Comp. Zool., vol. 43, no. 6, p. 264.

?*Clathrodrillia resina* Dall, 1919, Proc. U. S. Nat. Museum, vol. 56, no. 2288, p. 16, pl. 2, fig. 4.

A description of our shell is as follows: The shell is moderately large, slender, fusiform, only the last 2 whorls remaining. The anal fasciole is wide, about one-third of the interval between the sutures on the penultimate whorl, and in its smoothness differing conspicuously from the rest of the shell. The principal sculpture consists of close, slightly inclined, weak riblets which commence faintly on the base at a point about opposite the middle of the aperture and extend upward, ending at the lower edge of the fasciole; and crowded spirals, alternating in strength. The riblets number about 22 on the last whorl but are faint or absent immediately back of the thickened outer lip; on the penult whorl between the lower suture and the anal fasciole there are 5 or 6 spirals, the lower 4 with alternating secondary ones. On the last whorl there are about 14 principal spirals with additional ones on the anterior canal, the upper ones having secondary spirals between them; aperture elongate-elliptical, the outer lip thickened, smooth within; the inner lip with a spread of callus and a tooth above. Anal sinus moderately deep, lying in the center of the fasciole.

Length 31 mm. (imperfect), diameter 14.5 mm., aperture 22 mm.

We have only one specimen of this species, which has lost most of the spire. From the preceding species it differs by its more numerous ribs and spirals. The type specimen of Dall's *Clathrodrillia resina* was also an imperfect shell, dredged in the Gulf of Panama in 322 fathoms of water. It is a larger shell, the outer lip being defective.

*Occurrence*.—Canoa formation, Punta Blanca.

**Clathrodrillia woodringi** new species

Plate 2, fig. 8.

Shell of medium size, slender; nucleus of about 3 whorls, smooth, the first turn very small, the rest convex, the last bluntly angular about the middle; change to the post-nuclear whorls abrupt; the post-nuclear whorls number about  $7\frac{1}{2}$  with both axial and spiral sculpture. The first post-nuclear whorls have 2 strong spirals which cross the summits of the axial ribs and are rendered more or less nodose by them; on the penultimate whorl there are 5 spirals between the suture and the fasciole, the upper 2 being close, the others widely separated; on the last whorl there are 13 spirals, the upper 4 or 5 nodose by intersection of the axial ribs, the rest smooth. Axial sculpture of small, slightly oblique ribs numbering about 21 on the last whorl, which do not cross the sutural fasciole; sutural fasciole is a narrow, concave zone with a cord bordering the suture; aperture sub-elliptical, lengthened forward into the anterior canal; outer lip thickened, smooth within, with a rather deep anal sinus and a callous nodule on the parietal wall. There is a smaller stromboid notch at junction of the crenate outer lip with the anterior canal.

Length 19 mm., diameter 6.5 mm., length of aperture 8.4 mm. Type.

Length 24.25 mm., diameter 13 mm., length of aperture 11 mm.

This fine species is fairly common in the *Lucina* zone at Punta Blanca. It is named for Dr. W. P. Woodring, of the United State Geological Survey.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13635.

**Crassispira guayana** new species

Plate 2, fig. 2.

Shell of average size, solid, stout, of a yellowish to brownish color; spire widely conic, about half the length of shell; whorls  $5\frac{1}{2}$ , apex lost. The anal fasciole is a wide, collar-like convex band sculptured only with low, unequal spiral cords and defined below by a groove where the axial ribs end suddenly. Axial sculpture of narrow, slightly oblique ribs (on the last whorl about 15 or 16), which begin on the base at a point about opposite the middle of the aperture and extend upward to the edge of the anal fasciole where they bend abruptly backwards; their interspaces are sculptured with rather weak spiral cords, fairly regular above, where they number 5 or 6 on whorls of the spire, but somewhat less strongly developed on the base, with wider interspaces. Aperture narrow, somewhat contracted, the outer lip greatly thickened, with a rather deep anal sinus and a small but distinct stromboid notch near the anterior end. Inner lip with a spread of callus on the parietal wall which posteriorly is greatly thickened, filling the posterior angle of aperture and extending above the anal sinus to the edge of the anal fasciole.

Length 17.5 mm., diameter 7.9 mm., aperture 10.5 mm. Type.

This species resembles *Crassispira tepocana* Dall (Proc. U. S. Nat. Mus., vol. 56, no. 2288, p. 25, pl. 6, fig. 5), originally described from Cape Tepoca, Lower California, but also known to occur in the Pleistocene of southern Panama (Burica). Our shell differs by its stouter form, wider spire whorls, more numerous ribs and in other details.

*Occurrence*.—Jama formation, Puerto Jama. Type A.N.S.P. 13641.



**Nannodiella meridionalis** new species

Plate 9, figs. 7, 8.

The very small, slender shell has about 3 well-rounded, smooth embryonic whorls. A keel then arises at the anterior third, soon becoming nodose at regular intervals, 1 or 2 somewhat nodose cords appearing between the keel and the lower suture. The last whorl has 2 nodose keels, a smaller one between them. About 13 or 14 nodes on the last whorl. Base with about 10 subequal spiral cords. The anal fasciole or slope above the upper keel is wide, flat, with fine rather deeply arcuate growth lines, which are enlarged at intervals, corresponding to the nodes on the keel. The aperture is rather wide above, tapering anteriorly. Anal notch is deep, rounded, its borders produced, forming a short spout directed outwardly. Lip and columella are smooth within.

Length 3.8 mm., diameter 1.7 mm. Type.

This species resembles *Nannodiella nana* Dall, the genotype of *Nannodiella*, from the Gulf of California. It differs from that species by its stronger spiral sculpture and from other species of *Nannodiella* by its smoothish sutural fasciole.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13729.

**Mangelia ecuadoriana** new species

Plate 9, fig. 9.

The shell is very small, fusiform, solid;  $2\frac{1}{2}$  nuclear whorls, the first  $1\frac{1}{2}$  smooth and convex; the next with 4 or 5 low spiral cords and weak axial waves. Subsequent whorls with sculpture of very strong, rounded axial ribs, about equal to their intervals, 8 on the last whorl. They extend from suture to about the middle of the basal slope. Over all are fine, nearly equal spiral threads, 4 or 5 on the penult whorl, numerous on the last turn. The narrow aperture has no noticeable anal sinus. The anterior canal is rather narrow and straight.

Length 3.2 mm., diameter 1.8 mm. Type.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13727.

**Mangelia heptapleura** new species

Plate 9, fig. 5.

Shell small, with rather long spire, the apex rather blunt; first whorl convex, smooth, following whorl with numerous spiral cords decussated by weak, narrow axial riblets. Later whorls are weakly angular in the middle by the prominence of a wider spiral cord there, this angulation being at the shoulder of the last whorl; the rest of the surface showing very weak fine spirals. Axial sculpture of strong rounded ribs, decidedly narrower than their intervals, 7 of these strong ribs on the last whorl. There is an extremely shallow anal sinus.

Length 5.2 mm., diameter 2 mm.; about 7 whorls. Type.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13726.

**Mangelia hesperia** new species

Plate 9, fig. 6.

Shell small, fusiform, with a slightly obtuse apex, the first whorl smooth, the second decussate with fine spiral cords and weak, narrow axial riblets. The following whorl has about 6 spiral cords, the lower 2 large, and

numerous narrow, protractive axial riblets. Later whorls with many low spiral cords and strong axial ribs, much narrower than their intervals, 9 on the last whorl. Siphon is rather long and narrow.

Length 6 mm., diameter 2.5 mm.;  $6\frac{1}{2}$  whorls. Type.

The spire is shorter than in *M. heptapleura*, but the anterior canal longer.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13728.

### CANCELLARIIDAE

*Cancellaria* (*Cancellaria*) *ventricosa* Hinds

*Occurrence*.—Jama formation, Puerto Jama.

*Cancellaria* (*Cancellaria*) *decussata* Sowerby

*Occurrence*.—Canoa formation, Punta Blanca.

*Cancellaria* (*Cancellaria*) *urceolata* Hinds

*Occurrence*.—Canoa formation, Punta Blanca.

*Cancellaria* (*Cancellaria*) *obesa schucherti* Olsson

Typical *C. obesa* from the recent West Coast fauna is a globose species with a large, convex body-whorl. The fossils from both Punta Blanca and from the Tumbes beds of northern Peru are large, elongated shells with a narrower body-whorl, shorter spire and stronger sculpture. (For figure see Olsson, 1932, *Bull. Amer. Paleontology*, vol. 19, p. 162, pl. 17, figs. 3, 4.) These shells differ strikingly from typical *obesa*, but there is a similar recent specimen in the Academy's collection from Guaymas, Mexico. Until a larger series is available for comparative study of range of variation, it seems best to consider the elongated form we are calling *schucherti* as a subspecies of *obesa*.

*Occurrence*.—Canoa formation, Punta Blanca.

*Cancellaria* (*Cancellaria*) *yolandia* new species

Plate 4, fig. 3.

Shell of medium size, with a high, pointed spire about half the length of the shell; whorls 7 (nucleus not preserved), those of the spire narrowly shouldered; sculpture reticulate, formed by nearly equal spiral cords and numerous, fine, slightly inclined, longitudinal riblets; on the penultimate whorl there are 6 spiral cords, the uppermost one adjacent to the suture being small, the others heavier and approximately of equal size and separated by nearly smooth interspaces of twice their width; on the last whorl there are 14 spirals between the upper suture and the fasciolar keel; between the upper 9 spirals the interspaces are smoothish while between the lower 5 spirals, the interspaces have a single, intermediate, secondary thread; on high magnification, the interspaces show very minute spiral threads or striae; longitudinal riblets very numerous, approximately 36 in number on the last whorl; aperture semielliptical, the outer lip with a series of 9 strong lirae within; columella with 2 strong, bifid folds, the upper one being twice as heavy as the lower; parietal wall with a thin spread of callus and a single small elongate tooth: back of body-whorl usually a little humped,

and there are weak traces of former resting stages at quarter turn intervals; beak with a recurved siphonal sinus.

Height 30.7 mm., diameter 17.5 mm., aperture 17 mm. Type.

The distinguishing characters of this species are its high spire, evenly reticulated sculpture and strongly bifid columellar folds.

*Occurrence*.—Jama formation, Punta Borracho. Type A.N.S.P. 13648.

**Cancellaria (Cancellaria) jipijapana** new species

Plate 4, figs. 1, 4.

Shell of medium size, ovate with a high spire; there are 5 or 6 more or less shouldered, post-nuclear whorls; below the shoulder the sides of the whorls are straight to slightly convex, the last whorl contracted about the base and produced forward to form the beak; sculpture consists of strong, strap-like, spiral cords which are a little stronger on the shoulder and there separated from the spiral below by a wider interspace; the last whorl has 13 spirals between the siphonal fasciole and the shoulder, with 2 above; on the middle of the body-whorl the interspaces are of nearly the same width as the spiral cords. Axial sculpture consists of narrow, straight to slightly oblique, riblets which number about 22 on the last whorl. Aperture narrow, outer lip not varixed, usually smooth or weakly lirate within; pillar with 2 inclined folds, the upper one being the largest.

Height 34.5 mm., diameter 20 mm., length aperture 21.7 mm.

Height 36.8 mm., diameter 21 mm., length aperture 22.5 mm.

Height 37.5 mm., diameter 22 mm., length aperture 23.5 mm. Type.

This species resembles *Cancellaria urceolata* Hinds, but is distinguished by its coarser sculpture.

*Occurrence*.—Punta Blanca beds. Type A.N.S.P. 13647.

**Cancellaria (Cancellaria) dolioides** new species

Plate 3, fig. 5.

Shell small, imperforate, obesely oval. Whorls about 7, of which the first 3 are nuclear and smooth, the following  $1\frac{1}{2}$  turns are sculptured with 4 plain spirals separated by wide interspaces, and at this point there is a rather marked change in sculpture with the introduction of axial riblets on the following turns; on the penultimate whorl the sculpture has 5 spiral threads of which the upper 2 are small and crowded; the middle zone has 3 wide interspaces with the 2 central spirals strongly developed and nodulated by the longitudinal riblets; on the last whorl there are 11 principal spiral cords, evenly spaced, with wide interspaces, together with 4 or 5 small spirals on the anterior canal and 2 threads below the suture; there are about 17 axial riblets, about half as wide as their intervals, and extending continuously from the base to the suture. Aperture semielliptical, outer lip thin, smooth within or very feebly fluted by the external sculpture; inner lip with a thin wash of callus; columella straight, with 2 strong simple folds and a very small one bounding the anterior canal. Beak straight, only slightly recurved, and without a distinct siphonal fasciole.

Length 17.7 mm., diameter 12.2 mm. Type.

Of this species we have only a single specimen, which is perhaps immature. From *Cancellaria decussata* it differs by its thinner, imperforate shell, and in the features of its nuclear and post-nuclear whorls.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13643.

**Cancellaria (Cancellaria) cominella** new species

Plate 3, fig. 7.

Shell small, imperforate, with a fine, regular, reticulate sculpture; whorls 5, of which the first  $2\frac{1}{2}$  are nuclear and smooth; the post-nuclear whorls have 6 spiral threads between wider interspaces, with the upper spiral lying close to the suture, the intervals between the upper 3 wider than those following; on the last whorl there are about 17 spirals, separated by wide interspaces. These are crossed by about 24 narrow axial riblets which slowly increase in size and spacing as they approach the aperture. Aperture semielliptical, the outer lip thin, smooth within; columella straight with 2 prominent simple folds and a very small third one bounding the anterior canal, which is straight, not recurved.

Length 16.4 mm., diameter 10.2 mm.

The only specimen known is perhaps immature, but it cannot be identified with any known species. It is very much like *C. dolioides*, but with finer sculpture and less obese shape. The diameter/height index in this species is about 62, while in *dolioides* it is slightly over 69.3.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13643.

**Cancellaria (Euclia) pacifica** new species

Plate 3, fig. 4.

Shell quite large, robust, coarsely sculptured; spire high, but less than half the height of the shell; whorls 5 (nucleus lost), roughly shouldered with deep, excavated suture; the spire-whorls are distinctly shouldered but this shoulder becomes less pronounced on the back of the body-whorl whereas in *C. cassidiformis* it is mainly indicated by a row of short spines; on the earlier whorls the sculpture is formed by 5 coarse spiral cords separated by spaces of about the same width, and crossed and nodulated by a series of inclined riblets; on the penult whorl the middle spiral forms the edge of the shoulder or angulation, and is rendered nodose by the intersection with the axial riblets; this shoulder angle becomes strongly spinose on the last whorl. On the back of the body-whorl there are about 10 or 11 spiral cords below the shoulder, alternating with secondary cords in the intervals. Columella with 3 folds, the lowest or anterior one being very small. Aperture subelliptical, the outer lip a little thickened, deeply lirate within with about 13 lirae. Callus on the parietal wall is strongly lirate. Anterior canal is very little recurved, but without a strong siphonal fasciole.

Height 40 mm., diameter 27 mm., aperture 27.5 mm.

We have only one specimen of this species, which is somewhat related to the recent *C. cassidiformis* Sby.

*Occurrence*.—Jama formation, Puerto Jama. Type A.N.S.P. 13645.

**Cancellaria (Euclia) harpiformis** new species

Plate 3, figs. 1, 2.

Shell large, resembling *C. obesa* by the narrow aperture, in general form similar to *C. cassidiformis* but differing in lacking the shoulder spines of that species, and by its finer spiral threaded sculpture on the back of the body-whorl; in form, the shell is oblong with a large body-whorl and small spire, the aperture about  $\frac{3}{4}$  of the shell length; suture narrowly excavated; whorls 5 after the lacking nucleus, those of the spire moderately convex with 5 or 6 strong, spiral threads; the spirals increase greatly in number on

the last turn and become fine and unequal on the back of the body-whorl, coarser on its anterior portion. There are about 15 irregularly shaped and somewhat retractive fold-like ribs on the last whorl. Aperture broadly elliptical, strongly contracted at the narrow upper end, the outer lip flaring just below the middle, slightly thickened and smooth within, but showing slight traces of short lirae. Columella with 3 folds, the smallest bounding the anterior channel. There is a patch of small pustules on the side between the outer ends of upper 2 folds. A thin spread of callus over the inner lip unites above with the outer lip at a well marked posterior sulcus. Anterior canal moderately long, not recurved, and without a strong siphonal fasciole.

Height 43 mm., diameter 27 mm., length aperture 34.5 mm. Type.

Although superficially like *C. cassidiformis*, this species is clearly distinct, differing constantly in lacking the shoulder spines, by its finer spiral sculpture and especially by the narrow mouth, contracted above. We have 4 specimens, all from the base of the Canoa formation at Punta Blanca.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13644.

***Cancellaria (Euclia) cassidiformis* Sowerby**

Very common. *Cancellaria larkinii* Nelson (Olsson, 1932, *Bulls. Amer. Paleontology*, vol. 19, pp. 159, 160, pl. 17, figs. 5, 7) from the Tumbes beds of northern Peru, is related to this species but differs by its higher spire, stronger ribs and spirals.

*Occurrence*.—Canoa formation, Punta Blanca.

***Cancellaria (Euclia) cremata* Hinds**

Not common. Closely related to this species is *Cancellaria triangularis* Nelson, from the Upper Miocene of Peru (see Olsson, 1932, *Bulls. Amer. Paleontology*, vol. 19, p. 158, pl. 18, figs. 1, 2).

*Occurrence*.—Canoa formation, Cancellaria zone.

***Cancellaria (Peruclia) solida* Sowerby**

*Occurrence*.—Jama formation, Puerto Jama.

***Cancellaria (Peruclia) bulbulus* Sowerby**

*Occurrence*.—Jama formation, Puerto Jama.

***Cancellaria (Ovilia?) cumingiana* Petit**

Not common.

*Occurrence*.—Canoa formation, Punta Blanca.

***Cancellaria (Tribia) bahia* new species**

Plate 3, fig. 3.

Shell small, subfusiform, the spire high, about half the length of the shell; whorls 6 (nucleus not preserved) strongly and widely shouldered; the sculpture consists of spiral cords and fairly strong inclined riblets spaced as follows: on the penultimate whorl there are 3 strong spiral cords separated by much wider, smooth, interspaces between the lower suture and the

shoulder, the shoulder angle has a double spiral while the area above the shoulder is marked with 3 small threads; on the body-whorl are 8 spirals between the shoulder angle and the small umbilicus; the riblets number about 11 and extend from the suture to the beak; aperture subcircular, ending in a short beak, columella with 3 small, inclined folds, outer lip smooth within.

Height 14 mm., diameter 8.25 mm., aperture 7 mm. Type.

*Occurrence*.—Canoa formation, Punta Blanca.

***Cancellaria (Narona) pajana* new species**

Plate 3, fig 6.

Shell small, fusiform, the spire about as long as the aperture; whorls 5+, nucleus missing, rugosely convex; sculpture consists of strong ribs and regular, widely spaced spirals; on the early post-nuclear whorls the ribs are strong with interspaces of the same width, crossed by 2 spiral threads, on the penult whorl there are 6 strong spirals and a smaller one between the topmost principal spiral and the suture; on the body-whorl there are 13 principal spirals between the upper suture and the tip of the anterior canal; the spaces between the spirals are about twice the width of the spirals themselves; ribs on last whorl begin on the anterior canal and extend upward to the suture and are feebly noded by the crossing of the spiral threads; they number 12 to 14 on the last whorl; aperture subelliptical, drawn-out anteriorly into a long and somewhat twisted canal, columella with 2 strong plaits.

Length 13.55 mm, diameter 5.25 mm, aperture 8 mm. Type A N.S.P. 14485.

The only specimen we have of this species is fragmentary, but it is so distinctive that it should be easily recognized if found again. The outer lip is defective, so that the anterior canal appears longer and more slender than it would in a perfect shell. From *Cancellaria clavatula* Sowerby it differs by its more solid, non-shouldered whorls, and varices, if present at all, are poorly developed.

*Occurrence*—Canoa formation, Punta Blanca.

***Trigonostoma ecuadoriana* new species**

Plate 3, figs. 8, 9; plate 5, fig. 2.

Shell large, solid, strongly sculptured with coarse, deeply cut spiral cords; spire of medium height, composed of about 5 convex whorls, of which the upper 1½ turns belong to the smooth nucleus; sutures bordered by a wide, deeply channelled zone so that the upper edge of the whorls appear strongly shouldered on the later turns; on the early whorls the sculpture consists of small, fine spirals which become increasingly coarser with age and on large shells become coarse, nodose cords which number about 14 from the shoulder to the edge of the umbilicus; these cords are rendered sharply nodose by unequal, unevenly spaced longitudinal folds which on the shoulder form short spines, and in the sutural channel, elevated scales; inside of the funnel-shaped umbilicus is sculptured likewise by coarse spiral cords; under the lens the summits of the spiral cords are seen to be finely striate in the same direction. Aperture broad, the outer lip with a series of long lirae within, inner lip with a thick parietal callus; columella provided with 1 strong fold and sometimes with a very small, subsidiary one below.

Height 40 mm. (imperfect), diameter about 35 mm. Type.

This species is quite common at the base of the Pliocene beds at Punta Blanca but the shell is invariably broken or more or less decayed. From fragmentary examples it clearly reaches a much greater size than the above measurements indicate.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13646.

### OLIVIDAE

#### *Oliva polipasta* Duclos

Most of our specimens are more strongly shouldered than typical for this species but they can be duplicated by specimens in the collection of the Academy from Lower California. These broad shells resemble the common form of *Oliva peruviana* Lamarek, but are distinguished from that species by their lirate parietal wall. Feeble color markings are preserved on some shells.

*Occurrence*.—Canoa formation, Punta Blanca.

#### *Oliva kaleontina* Duclos

A recent species, represented by some specimens from Punta Blanca. Recent specimens can be distinguished by the violet-colored nucleus.

*Occurrence*.—Canoa formation, Punta Blanca.

#### *Oliva angulata* Lamarek

Several large shells from Jama. They are indistinguishable from recent examples.

*Occurrence*.—Jama formation, Puerto Jama.

#### *Oliva araneosa* Lamarek

This is the common *Oliva* in the beds at Jama.

*Occurrence*.—Jama formation, Puerto Jama.

#### *Olivella gracilis* Broderip & Sowerby

Plate 8, figs. 4, 5.

The specimens are rather small.

Length 12.9 mm., diameter 4.7 mm., aperture 7.5 mm. long.

*Occurrence*.—Canoa formation, Punta Blanca.

#### *Olivella semistriata* Gray

*Occurrence*.—Jama formation, Puerto Jama.

### MARGINELLIDAE

#### *Marginella (Egouana) incrassata* Nelson

*Marginella incrassata* Nelson, 1870, Trans. Conn. Acad. Sci., vol. 2, p. 197, pl. 6, figs. 5, 6.

*Marginella incrassata* Spieker, 1922, Johns Hopkins University, Studies in Geology, no. 3, p. 43, pl. 1, fig. 9.

*Marginella incrassata* Olsson, 1932, Bulls. Amer. Paleontology, vol. 19, pp. 165, 166, pl. 20, figs. 2, 6.

This species is common in the Upper Miocene of northern Peru and in the Pliocene of Punta Blanca but it is not known to be living. It varies considerably in size from small but fully matured types only 17 mm. to others 35 mm. or more in length. The outer lip is smooth within, the spire low to moderately elevated. The columella has 4 strong lirae.

*Occurrence*.—Canoa formation, Punta Blanca.

***Marginella (Gibberula) minor*** C. B. Adams

*Occurrence*.—Canoa formation, Punta Blanca.

***Marginella*** species undetermined

*Occurrence*.—Canoa formation, Punta Blanca.

### MITRIDAE

***Mitra (Tiara) gigantea polystira*** new subspecies

Plate 2, fig. 4.

The shell is large, elongate, strongly sculptured with coarse encircling cords which number about 13 on the last whorl; on the penultimate whorl there are about 7 spiral cords between the lower and upper sutures, the lowest cord lying in or very close to the suture while the upper 2 are much smaller than the others; the middle cords on the body-whorl tend to be double or irregular; between the spiral cords, the intervals are marked with a few faint spirals. The last whorl is a little shouldered and slightly compressed about the middle. Aperture narrow throughout; columella with 3 strong plaits and 2 small, weak ones below.

Length 66 mm. (imperfect), diameter 20 mm. Type.

From typical *M. gigantea*, described from the coast of Ecuador ("Xipixapi", probably the present Callo or Port of Jipijapi), the fossils differ in being usually larger and in having the last whorl more shouldered. In *polystira* the cords are not so high, number about 13 on the last whorl and generally several are double in the middle of the whorl. A fragment in the collection, having only the last whorl remaining, has a length of 65 mm., indicating a full-grown shell nearly 100 mm. long.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13638.

***Mitra (Mitraria) swainsoni*** Broderip

*Occurrence*.—Canoa formation, Punta Blanca.

### FASCIOLARIIDAE

***Fusinus panamensis*** Dall

A fragment of the body-whorl only. This species was recorded by Dall from the Pliocene beds of Indefatigable Island, Galapagos.

*Occurrence*.—Canoa formation, Punta Blanca.



## BUCCINIDAE

*Hanetia ecuadorensis* new species

Plate 4, figs. 10, 12.

The shell is of medium size, subfusiform with the spire nearly as long as the anterior slope; whorls  $6\frac{1}{2}$  (tip of spire eroded), sculptured by strong axial folds on the last whorl, strongest at the periphery, obsolete near the suture and on the base, crossed by close, unequal spiral threads, several small ones between each pair of larger, the suture following at a point a little below the angle of the shoulder; on the last whorl the ribs number about 11 and extend from the base across the shoulder to the suture above; the spirals are moderately coarse, more or less alternating in strength, while on the base the larger spirals are coarser, cord-like. Aperture elliptical above, prolonged forward in a narrow and recurved anterior canal; outer lip sharp, a little receding above, more strongly so below, and internally provided with a series of long slender lirae; columella excavated, smooth; the anterior canal with a strongly convex siphonal fasciole. There is a minute umbilical chink.

Height 43.5 mm., diameter 25.5 mm., aperture 26.5 mm. Type.

This species bears some resemblance to *Hanetia alternata* Nelson,<sup>8</sup> from

<sup>8</sup> Spieker, 1922, The Paleontology of the Zorritos Formation of the North Peruvian Oil Fields. Johns Hopkins University, Studies in Geology, no. 3, p. 45, pl. 1, figs. 10, 11. the Upper Miocene beds of northern Peru, but differs by its higher spire and more slender form.

Occurrence.—Jama formation, Puerto Jama. Type A.N.S.P. 13650.

*Hanetia cymioides* new species

Plate 5, fig. 1.

The shell is large and moderately solid with a conic spire about half the length of the aperture; whorls 4+ (apex lost) the last with a subangular periphery well above the middle, bearing conic or spine-like nodes at regular intervals, 9 on the last whorl; sutures appressed, the coiling following a little below the periphery. Spiral sculpture of very fine, crowded threads, which at intervals of 4 or 5 threads are a little larger; on the concavity of the anterior slope there are more prominent cords, which with their intervals have the same fine, crowded threads. Aperture elliptical above, produced into a recurved anterior canal; umbilicus of moderate width, bordered by a very strong siphonal fasciole; outer lip deeply crenate within, the edge notched; columella with a covering of callus, no fold.

Height 50 mm., diameter 31 mm., length aperture 37 mm. Type.

In shape as well as general type of sculpturing, this species resembles *Cymia*, but the columella is smooth and unarmed. The minute sculpture is similar to that of *H. ecuadorensis*.

Occurrence.—Jama formation, Puerto Jama. Type A.N.S.P. 13672.

*Hanetia fusiformis* Blainville

Occurrence.—Canoa formation, Punta Blanca.

*Hanetia boggei* new species

Plate 5, figs. 3, 4.

Shell similar to *H. anomala* Reeve but distinguished by its more numerous ribs, there being 15 to 17 on the last whorl, while the recent species

usually has 9 to 11; the shoulder of the body-whorl is rounded, the ribs being small and crowded. On the last whorl the spiral sculpture is formed by 15 strong spiral cords, 3 of which are on the slope above the shoulder, the sutural one being the strongest; the spiral cords are separated by deeply grooved spaces, both the spirals and their intervals being covered with many finer threads; aperture subelliptical, the outer lip toothed by the ends of the spirals and lirate within.

Height 43.8 mm., diameter 28 mm., last whorl 35 mm., aperture 29 mm. Type.

This species is closely related to *H. anomala* Reeve of the coast of Ecuador and northern Peru, but as noted above, is easily distinguished by its more numerous axial ribs. *H. anomala* Reeve has often been confused with *H. pallida* Broderip and Sowerby, which as yet has not been recorded from the southern part of the Panamic Province. That species differs by its higher spire and more angular periphery. In *anomala* and *boggsi*, the spiral sculpture is very coarse and rope-like in appearance, and covers the whole surface equally, including the area above the shoulder.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13673. Jama formation, Puerto Jama.

#### *Hindsia wheeleri* new species

Plate 5, fig. 10.

Shell small, solid; whorls about 8 of which the first 2 are nuclear, smooth, except the last quarter turn which has weak spirals; the post-nuclear whorls are strongly sculptured by ribs and spirals; the sculpture of the spire-whorls consists principally of 2 strong spiral cords which form the middle of the whorls, these spirals are crossed, and rendered strongly nodose, by axial ribs; on the shoulder area, there are 2 smaller spirals with 2 others on the area between the lower suture and the lower of the 2 primary middle spiral cords; the sculpture is similar on the body-whorl with 4 spirals on the base and about 8 strong ones on the beak; there are 9 ribs on the last whorl beside the enlarged, thickened lip; on the last whorl the sutural zone becomes a deep, smooth channel which unites with another channel behind the outer lip; aperture is small, ovate, continuous with a raised, inner rim; outer lip doubling back on itself, forming a wide varix, more or less hollow within; beak long, recurved at the tip and carrying the anterior canal.

Length 17 mm., diameter including varix 9.5 mm. Type A.N.S.P. 14483.

This species is related to *Hindsia acapulcana* Pilsbry & Lowe from Acapulco, Mexico, but has a shorter spire, larger body-whorl, heavier lip and its peristome is continuous or entire, the canal being completely closed or roofed over.

*Occurrence*.—Canoa formation, Punta Blanca.

### NASSARIIDAE

#### *Nassa cinosa* new species

Plate 6, figs. 6, 7.

Shell small, with a medium length spire more than half the length of the shell; whorls about 7 of which the first 3 are nuclear and smooth; the sculp-

ture of the post-nuclear whorls is rather rough, formed by coarse spirals and ribs. The earliest post-nuclear whorls are convex with uniform spiral threads, but on the penultimate and body-whorl a spiral about a fourth from the suture is a little more prominent, forming a narrow shoulder. On the last whorl the spirals are fairly strong threads, separated by narrower deep intervals, are fairly regular except at the base, where they are slightly larger and more widely spaced. There are about 19 or 20 on the last whorl. The last turn has about 14 axial ribs, rather strong, rounded, about equal to their intervals. They tend to weaken below the periphery of the whorl in some examples, and are irregular and crowded behind the thickened outer lip; aperture subcircular, the outer lip blunt, weakly crenulated within. The inner lip is heavily calloused, anterior canal deep, the siphonal fasciole bounded by a deep, encircling sulcus.

Length 13.5 mm., height 8.2 mm., aperture 7 mm. Type.

*Occurrence*.—Jama formation, Puerto Jama. Type A.N.S.P. 13679.

***Nassa palta* new species**

Plate 6, figs. 4, 5.

Shell small, solid, with a blunt spire about half the length of the shell; whorls about 6 of which the first  $3\frac{1}{2}$  are nuclear, rather large, smooth, white with very faint spirals appearing on the last quarter turn. The first post-nuclear whorl is marked by about 5 flat spiral bands, the posterior one is a little stronger but strengthens rapidly on the succeeding whorls to form a prominent sutural cord, usually more or less strongly beaded; the penultimate whorl has about 6 flat, smooth spiral bands including the sutural, separated by linear grooves; the last whorl has 10 spiral bands between the suture and the siphonal fasciole; axial sculpture is poorly developed, mainly as node-like ribs on the penultimate whorl or below the suture on the last whorl; aperture small, subelliptical with a notch-like posterior canal and a deep anterior canal; outer lip strongly thickened, and with about 9 small denticles within.

Length 5 mm., diameter 3 mm., last whorl 3.75 mm., aperture 2.75 mm. Type.

Distinguished by its large nucleus and sculpture of smooth spiral bands and nearly obsolete ribs.

*Occurrence*.—Punta Blanca beds. Type A.N.S.P. 13678.

***Nassa cara* new species**

Plate 6, figs. 1, 2.

Shell small, with a short, conic spire; whorls about 6, of which the first 2 are nuclear, smooth; the first and second post-nuclear whorls are sculptured with 3 spiral threads, beaded by small, obliquely set riblets; on the penultimate whorl the spirals increase to 5 and on the body-whorl, 8 to 9; on the larger shells the sculpture on the body-whorl becomes principally a series of obliquely set beads upon the axial riblets, which number about 17; a deep, encircling groove marks off the siphonal fasciole. Siphon short, thick, recurved. Aperture small, widely subelliptical, the outer lip thickened by a strong but narrow varix, internally denticulate or lirate; posterior end of aperture with a small sinus defined by a small tooth on the parietal wall; siphonal canal deep.

Height 6.8 mm., diameter 4.5 mm. Type.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13677.

***Nassa pacis* new species**

Plate 8, figs. 6, 8.

Shell small, spire and aperture of about equal length; whorls about 9, the first 3 to  $3\frac{1}{2}$  belonging to the nucleus being smooth, the others sculptured by axial folds crossed by spiral threads; on the earliest whorls the spirals number 8 or 9, are small and nearly equal in size, later the lower 6 threads become wider and flatter while the 3 upper ones adjacent to the suture remain small and in addition have a small secondary thread in their interspaces; on the body-whorl the spirals become flat, strap-like and are separated by narrower intervals except those near the basal sulcus which are convex and coarser. Axial ribs on the last whorl number about 11, the last forming the strongly thickened outer lip; aperture subcircular, the outer lip thickened, smooth or weakly denticulated within; inner lip with a heavy callus and an entering tooth above; anterior canal short, appressed, twisted, the convex siphonal fasciole bounded by a deep narrow groove.

Height 17.8 mm., diameter 10.4 mm., aperture 10.5 mm. Type.

This shell is related to *Nassa angulicostis* Pilsbry and Lowe, but is larger, wider and the parietal callus is heavier.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13690.

***Nassa (Perunassa) ecuadoriana* new species**

Plate 4, figs. 2, 8, 11.

Shell large, with a high, pointed spire of about 10 whorls; the protoconch is very small, composed of about 2 smooth, minute turns; the succeeding whorls have a reticulated sculpture of strap-like spiral cords, separated usually by somewhat wider interspaces, and narrow axial riblets; the earliest postnuclear whorls are nearly convex in profile but soon develop a depressed band about the upper suture which widening gives a shouldered aspect to the later whorls; the sculpture is subreticulate, persistent; it is formed of spiral threads and fine ribs; on the penultimate whorl there are usually 5 spiral threads between the shoulder angle and the lower suture, and 3 additional spirals in the depressed band above the shoulder; the spiral interspaces usually a little wider than the spiral threads, smooth, or have a fine, secondary thread; on the last whorl there are 3 primary spirals in the sutural zone with about 16 to 20 from the shoulder down over the face of the whorl to the siphonal fasciole; towards the base the intervals are usually provided with a simple secondary thread; the axial riblets number 19 to 21 on the last whorl, are narrow, fairly evenly spaced, and extend from the siphonal fasciole to the shoulder which they feebly coronate; aperture wide, irregularly oval, outer lip not thickened, smooth or very weakly liriate within, at its junction with the body-whorl there is an upward-directed, small, canal-like groove; the siphonal fasciole is slightly convex, bounded by a thin and inconspicuous keel; siphonal sinus deep, the end of the columella bordered by a fairly strong cord.

Height 36.3 mm., diameter 21.8 mm., aperture 21.3 mm. Type.

Height 35.5 mm., diameter 22 mm., aperture 20 mm., last whorl 27 mm.

Height 35.5 mm., diameter 18.5 mm., aperture 19 mm., last whorl 25.5 mm.

Height 34 mm., diameter 21 mm., aperture 20 mm., last whorl 25 mm.

Height 48 mm., diameter (imperfect), aperture 26 mm., last whorl 36 mm.

*Perunassa*° was first described as a subgenus of *Buccinanops* d'Orbigny, with *Argobuccinum zorritense* Nelson, from the Upper Miocene or Tumbes beds of northern Peru, as the genotype. *Perunassa zorritensis* Nelson is usually a larger and coarser species which at maturity develops a smooth and strongly coronated or shouldered body-whorl. Young shells however are strongly sculptured with spirals and then closely resemble the species here described. *Perunassa ecuadoriana* is also closely related to *Alectrion tropicalis* Dall and Ochsner,<sup>10</sup> described from beds of probably Pliocene age on Seymour Island, Galapagos; but the Galapagan shell differs, according to the description, by its feebler sculpture, which becomes obsolete on the last whorl, and by its deeper siphonal fasciole. Dall and Ochsner considered their species as belonging to Conrad's *Schizopyga*, a group of large Nassas well represented in the recent and Pliocene faunas of California. *Schizopyga* Conrad, which has *S. californiana* Conr. for its genotype, is however a distinct group, differing from the 3 species here enumerated by the deep furrow defining the siphonal fasciole.

*Occurrence* — Punta Blanca beds. Canoa formation, Punta Blanca. Type A.N.S.P. 13651. Jama formation, Puerto Jama.

*Nassa puntablancana* new species

Plate 5, figs. 5, 11.

Shell robust, with an obese body-whorl and a medium height spire; nucleus of 3 smooth whorls, the succeeding 6 post-nuclear whorls are strongly sculptured with spiral cords and ribs; the whorls are somewhat shouldered and there is often a slight difference in the strength of the spirals between those on the body-whorl and those which lie above the shoulder; on the penultimate whorl there are about 4 spirals below the shoulder and about 3 above, all being separated by smooth interspaces; on the body-whorl there are 4 spirals above and about 12 below the shoulder to the deep siphonal fasciole, these spirals are of equal strength; the ribs are strong on all the whorls and number 13 to 14 on the body-whorl, the last being larger and forms the somewhat thickened outer lip; aperture subcircular, the outer lip thickened by the last rib and internally carrying long, entering lirae; inner lip has a wide, spreading, parietal callus, veined or pustulate; there is a small anal groove at the upper end of the lip, bordered by a long, strong, entering ridge on the inner side; siphonal sinus deep, bordered on each side by strong lirae; the siphonal fasciole is very convex, sculptured with spiral cords and transverse riblets and bounded by a deep furrow.

Height 25 mm., diameter 18 mm., aperture 15 mm. Type.

Height 22 mm., diameter 17 mm., last whorl 16 mm., aperture 13 mm.

° Olsson 1932, Contributions to the Tertiary Paleontology of Northern Peru: Part 5, The Peruvian Miocene. *Bulla. Amer. Paleontology*, vol. 10, no. 68, p. 103.

<sup>10</sup> Dall and Ochsner, 1928, Tertiary and Pleistocene Mollusca From the Galapagos Islands. *Proc. Calif. Acad. Sci.*, Ser. 4, vol. 17, p. 109, pl. 2, fig. 9

This species differs from others of the Panamic Province by its larger size, obese figure and more regular spiral sculpture.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13674. Jama formation, Puerto Jama.

#### CYMATOPHOS new genus

Similar to *Phos* in general form and in sculpture, but with a simple, scarcely convex siphonal fasciole limited by a raised thread, not preceded by a furrow. Embryonic whorls smooth, convex. Outer lip slightly oblique with a small or feebly developed stromboid notch anteriorly, weakly lirate within.

Genotype.—*Cymatophos galerus* new species.

This is a well characterized group containing many fossil species such as the Miocene *Phos hodsoni* Olsson of Peru, *semicostatus* Gabb from Santo Domingo, the *subsemicostatus* Brown and Pilsbry and *veatchi* Olsson of Panama and Costa Rica. We have specimens of a recent species from southern Panama which is perhaps undescribed.

#### *Cymatophos galerus* new species

Plate 4, figs. 5, 7.

Shell rather large, strongly sculptured with ribs and spirals; whorls 9 or more, the nucleus imperfect, but so far as remaining like that of *Phos*. The sculpture is formed of spiral threads of primary and secondary strength which overrun the whole shell; the axial sculpture consists of strong, fold-like ribs, about 8 on the last whorl; these ribs are strongest on the middle of the whorl and diminishing near suture and on the base. On the penult whorl there are usually about 6 primary threads separated by much wider intervals which carry a slightly smaller secondary spiral; there are 27 spirals in all on the body-whorl, about 10 being secondaries; the suture bordered by a small cord. Aperture suboval, the outer lip strengthened by an external stronger or variceal rib at maturity, and with about 9 short lirae within; inner lip smooth, with a spread of callus which is free at the lower outer edge at maturity. Base of columella with a single oblique spiral cord, as in *Phos senticosus*; siphonal fasciole slightly convex, bounded above by a sharp raised line but no furrow.

Height 44 mm., diameter 21.5 mm., last whorl 30 mm., aperture 21 mm.

Height 38 mm., diameter 19 mm., aperture 20 mm. Type, fig. 7.

Height 53.7 mm., diameter 22.3 mm., last whorl 31 mm., aperture 26 mm.

*Occurrence*.—Jama formation, Jama Bay. Type A.N.S.P. 13649.

#### *Phos gaudens* Hinds

The ribs on the fossil are fewer in number but otherwise they are very similar to recent examples of this living species.

*Occurrence*.—Jama formation, Puerto Jama.

#### *Phos cocosensis* Dall

Only a few specimens, probably belonging to the recent species.

*Occurrence*.—Jama formation, Punta Cabuyal.

*Northia northiae* Gray

*Occurrence*.—Jama formation, Puerto Jama.

*Metula amosi* Vanatta

Fragment only.

*Occurrence*.—Jama formation, Puerto Jama.

*Cantharus elegans avus* new subspecies

Plate 6, figs. 8-9.

The shell is somewhat larger and more solid than *C. elegans* (Gray). Nuclear whorls lost; the early post-nuclear whorls with sculpture of rounded axial folds wider than their intervals, crossed by 2 prominent equal spiral cords, and several smaller ones on the sloping surface above them. The axial folds become very weak and irregular on the penult and part of the next earlier whorls, which have spiral sculpture as follows: a prominent bilirate spiral below the suture, followed by 2 spiral cords; a more prominent cord in the middle of the whorl, another below it, with unequal spiral threads between and below them. The last whorl is concave above the well-marked shoulder, which has about 8 prominent nodules. There are strong spiral cords with interstitial threads. The convex siphonal fasciole has about 7 spiral threads. The aperture occupies about half of the total length and is somewhat channelled posteriorly. Outer lip has short grooves within corresponding to the external cords. Columella straight above, with reflected callus, the parietal wall above it with a group of about 4 short ridges.

Length 55.3 mm., diameter 31.4 mm.;  $7\frac{1}{2}$  whorls remaining. Type.

The sculpture is more fully developed than in *C. elegans*, especially the nodules on the last whorl.

*Occurrence*.—Puna Island. Type A.N.S.P. 13681.

*Tritiaria*(?) *ecuadoriana* new species

Plate 6, fig. 3.

Shell small, *Metula*-like in form and sculpture; there are  $6\frac{1}{2}$  whorls, nucleus not preserved; the earlier, post-nuclear whorls have a Nassoid sculpture of 12 strong, rounded ribs about equal to their intervals, crossed by 7 strong spiral cords, strongest in the middle; this sculpture changes to one in which these ribs decrease rapidly in strength on the penult and next earlier whorls, being replaced by a subreticulate sculpture of narrow axial riblets and spiral cords, subequal in prominence. There are about 17 cords on the last whorl between the suture and the edge of the very low siphonal fasciole. Aperture subelliptical, the outer lip sinuous slightly thickened and lirate within, provided with a wide, stromboid notch; pillar with a single cord at margin of the well formed anterior canal.

Height 16 mm., diameter 7 mm., length of aperture 8.2 mm. Type.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13680.

## COLUMBELLIDAE

*Strombina lanceolata* Sowerby

*Occurrence*.—Canoa formation, Punta Blanca.

***Strombina recurva* Sowerby**

The fossil shells do not agree exactly with the common variant of recent *recurva* in that the riblets are more linear or less node-like, but occasionally similar shells are found amongst the recent forms.

*Occurrence*.—Jama formation, Puerto Jama.

***Strombina gibberula* Sowerby**

*Occurrence*.—Punta Blanca.

***Strombina ecuadoriana* new species**

Plate 5, figs. 7, 8.

Shell solid, with an inflated body-whorl and a conic spire of about 8 whorls; nucleus small, glassy, of about 3 turns; the post-nuclear whorls are more or less flat between the impressed sutures, and sculptured with strong, nearly straight, smooth ribs about equal to their intervals; there are about 16 to 17 ribs on the last turn, followed by a prominent, rounded varix at the thick lip; on the last whorl the ribs extend from the upper suture across the middle of the shell but quickly fade out before crossing the base, where the sculpture consists of 6 strong spiral cords. Aperture narrowly elliptical, more or less contracted, the outer lip greatly thickened and extended upward to the upper suture; it is internally strongly lirate and provided with a deep notch or indentation at the upper third, so that its outer profile is distinctly sinuous; a strong callous ridge on the parietal wall bounds a posterior sinus; columella with an erect callus plate with 8 strong rounded lirae a little distance from the outer edge, the upper 6 of even size; siphonal sinus deep and a little recurved.

Height 21 mm., diameter 11 mm., length of aperture 13 mm. Type.

A very distinct species, unlike any recent or fossil *Strombina* known from the West Coast.

*Occurrence*.—Jama formation, Puerto Jama. Type A.N.S.P. 13676.

***Bifurcium bifurcium* Fischer**

*Occurrence*.—Jama formation, Puerto Jama.

**STROMBINOPHOS new genus**

Shell of medium size, fusiform. Nucleus of several smooth, tapering whorls. Sculpture of post-nuclear whorls consists of strong ribs and spirals. Aperture long, widest above, tapering gradually forward to form a narrow and scarcely recurved canal. Outer lip broadly varicose externally with numerous strong lirae within. Inner lip with the callus only weakly denticulate.

*Genotype*.—*Strombinophos loripanus* new species.

By its apertural characters this genus appears decidedly more related to *Strombina* than to *Phos* and its allies, which it resembles by its sculpture of strong ribs and spirals. The outer lip does not appear to have the notch of *Strombina*, but it is not quite perfect in the specimens at hand. A small posterior groove is present at the posterior angle of aperture.



***Strombinophos loripanus* new species**

Plate 4, figs. 6, 9.

The shell is of medium size, fusiform with a high pointed spire longer than the aperture; whorls 11, of which the first 4 or more belong to the small, smooth, rapidly tapering nucleus, followed by the post-nuclear whorls which are strongly sculptured by ribs and spirals; on the earlier whorls of the spire there are 7 spiral cords of which the lower 5 are strong, the upper 2 or 3, small and crowded; on the penultimate whorl the spirals are similar but the posterior one lying along the suture is double; on the body-whorl the spirals number about 16 and extend from the edge of the siphonal fasciole to the suture; the ribs are strong, persistent, except on the last fourth of a turn back of the lip, where they give place to a broad, low, variceal swelling; they number about 9 on the penult turn. Aperture narrow, the outer lip thickened externally, with a series of 10 or 11 long, tooth-like lirae within; columella straight carrying a series of small, low teeth; anterior canal produced, nearly straight, with a small sinus at the tip, siphonal fasciole flat, with narrow spiral threads.

Length 32 mm., diameter 12.5 mm., aperture 15 mm. long. Type.

Length 25 mm., diameter 10 mm., aperture 11.5 mm.

A *Fusus*-like species recognized by its sculpture and by its moderately long, little-twisted anterior canal.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13671.

***Amphissa meridionalis* new species**

Plate 2, fig. 6.

Shell shaped about like *A. modesta* Powis; moderately solid. The worn apex is smooth. Later whorls with axial sculpture of close, rounded riblets, about equal to their intervals, straight on the early whorls, slightly arcuate on the penult and weakly sinuous on the last whorl, where there are about 32 riblets. Intervals are closely sculptured with spiral cords, 8 or 9 on the penult whorl, and coarser on the anterior part of the base, where the axial ribs disappear. The first 2 cords below suture are but weakly separated, a deeper but narrow spiral groove parting them from the following cords. The last whorl is slightly tumid behind the outer lip. Aperture is narrow, the outer lip liriate within; anterior canal short.

Length 21.5 mm., diameter 9 mm., length of aperture 10.5 mm. Type.

A more fully sculptured shell than *A. modesta* Powis.

*Occurrence*.—Puna Island. Type A.N.S.P. 13670.

**GLYPTAESOPUS new subgenus**

*Aesopus* with sculpture of axial ribs which are tuberculate where intersected by several weak spiral cords. Type *Aesopus xenicus* Pilsbry & Lowe.

***Aesopus (Glyptaesopus) perornatus* new species**

Plate 10, figs. 1, 2.

The shell is small, slender, the length over 3 times the diameter. First 2 whorls smooth, the next with rather weak axial ribs and 2 blunt and very low spiral cords, which form prominent tubercles where they intersect the ribs. On the last whorl there are 3 such spiral series of tubercles, and on the tapering base numerous weak spirals. Under a high power, extremely

fine, close spiral lines are seen on the best preserved specimens, between the cords. On the last whorl there are about 15 axial ribs. Aperture narrow, the anterior canal short.

Length 6.4 mm., diameter 2.3 mm.;  $7\frac{1}{2}$  whorls. Type.

*Occurrence*.—Canoa formation, Punta Blanca.

It resembles the recent *A. xenicus* Pilsbry & Lowe, but that is more slender, and the spiral striation is coarser. The axial ribs are more widely spaced than in *A. polylophus*.

There is also a more slender form measuring 5.7 mm. long, 1.7 mm. wide, with the same number of axial ribs.

***Aesopus (Glyptaesopus) polylophus* new species**

Plate 10, fig. 6.

The slender shell is similar in form to the preceding. After 2 smooth whorls the third whorl has many fine, close axial riblets, crossed by several low spiral cords, of which 2 are somewhat larger. Later whorls with coarse axial ribs about equal to their intervals, about 17 on the last whorl, crossed by numerous low unequal spiral cords of which 2 slightly predominate, but 4 or 5 are sufficiently large to form small tubercles where they intersect the ribs. On the last whorl the spirals are indistinctly alternating in size. The base has numerous unequal low spirals, and the axial ribs extend nearly to the origin of the anterior canal. The aperture is narrow, about as in *A. perornatus*.

Length 5.8 mm., diameter 1.8 mm.; 7 whorls. Type.

The close axial ribs and the details of the spiral sculpture distinguish this from *A. perornatus*. It does not show the extremely minute spiral sculpture of that shell.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13721.

## MURICIDAE

***Phyllonotus brassica* Lamarck**

Two specimens.

*Occurrence*.—Jama formation, Puerto Jama.

***Eupleura muriciformis* Broderip**

*Occurrence*.—Jama formation, Puerto Jama. Canoa formation, Punta Blanca.

## EPITONIIDAE

***Epitonium (Ferminoscala) manabianum* new species**

Plate 2, fig. 3.

Shell large, solid, with 10 or more compactly adherent whorls and a reticulate sculpture; surface dull. The axial sculpture consists of numerous narrow, slightly oblique, sharp lamellae, which are usually evenly spaced but occasionally are a little thickened or crowded where they mark former resting stages; the spiral cords number 4 to 5 on the earlier spire whorls, increasing to about 6 unequal ones on the later; these spiral cords are of unequal strength, 3 in the peripheral region being stronger, while between

these the intervals have several fine, rather indistinct spirals; the basal disk is overrun with fine spiral threads over which the axial laminae run, its edge being obtusely ridge-like after the end of the suture; the aperture is rounded, slightly patulous in the prolongation of the axis (and adult shells probably have the outer lip a little thickened).

Length 37.7 mm. (imperfect), diameter 18 mm. Type.

Length 31 mm., diameter 14 mm.

This shell is related to *Epitonium ferminianum* Dall of Panama Bay and Lower California, but differs in the details of its sculpture. In our shell the spirals are cord-like and heavier, usually becoming irregular as the shell matures.

*Occurrence*.—Punta Blanca beds in Zones K and *Lucina*. Type A.N.S.P. 13641.

***Epitonium (Ferminoscala) cleutherium* new species**

Plate 2, fig. 7.

Shell slender, acute, turritelloid with compactly coiled and beautifully sculptured whorls; there are 8 whorls in the type, the apex lost; sculpture reticulate but with the spiral dominating over the axial on all whorls; the axial lamellae are evenly spaced, slightly oblique and number about 32 on the last whorl; the spirals are strong cords, there being about 6 on the spire whorls, the 2 posterior being quite small on the earlier ones but become equal to the others on the later whorls; between these primary cords there is a finer system of secondary threads; basal disk present, spirally finely threaded, its edge formed by a wide, blunt cord; aperture subcircular.

Length 21.3 mm., diameter 7.3 mm. Type.

A small *Turritella*-like species, distinguished from the preceding by its more even sculpture and more elongate shape. It somewhat resembles the *Epitonium (Ferminiscala) brunneopictum* Dall, recent off Lower California, but differs in details of sculpture.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13640.

***Epitonium (Spiniscala) lorippanum* new species**

Plate 2, fig. 9.

Shell imperforate, white or yellowish with an acute spire of  $8\frac{1}{2}$  whorls, having lost not more than one. The sutures are deep, between loosely coiled rounded whorls; ribs about 12 on the last whorl, are thin but with slightly reflected or backwardly rolled margins so that they appear more solid than they really are; spinous at the shoulder; the ribs are fairly continuous over the suture into which they dip, and pass obliquely backward across each of the spire-whorls in succession; they continue over the base. Intervals between ribs are smooth or with very faint spirals. Aperture circular, peristome continuous, formed by the last variceal rib.

Length 13.7 mm., diameter 5.4 mm. Type.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13639.

**MELANELLIDAE*****Strombiformis paria*** Bartsch*Occurrence*.—Canoa formation, Punta Blanca.***Strombiformis inca*** Bartsch*Occurrence*.—Canoa formation, Punta Blanca.***Niso imbricata*** Sowerby*Occurrence*.—Canoa formation, Punta Blanca.**PYRAMIDELLIDAE*****Pyramidella (Longchaeus) elenensis*** Bartsch*Occurrence*.—Canoa formation, Punta Blanca.***Turbonilla (Mormula) loripana*** new species

Plate 10, figs. 3-5.

Shell large for the genus, white to porcelaneous; nucleus not seen; post-nuclear whorls numerous, rather narrow, convex, the convexity greatest below the middle. Sculpture of strong, axial ribs which end suddenly at the periphery, and number 19 to 20 on the last whorl; inter-costal spaces little wider than the smooth-topped ribs, and ornamented with about 7 (5 to 8), fairly regularly disposed, incised lines. Sutures strongly impressed; periphery of last whorl moderately well-rounded in adults; base little rounded to flattened, smooth or marked only with very faint spirals. Aperture subrhombic, the columella straight, internal fold not showing; varices few and indistinct, weakly developed through the thickening or fusion of the ribs on some whorls.

Length 13.8 mm., diameter 3.5 mm.; 17 whorls (nucleus missing). Type.

The varices are generally only very feebly developed, through the fusion or crowding together of the axial ribs on some whorls. The shell is quite large and striking in appearance, the whorls narrow, convex to slightly overhanging the lower sutures. The spiral lining in the intervariceal spaces is somewhat variable, fine and numerous in some cases to few and coarse in others. The species is quite common in Zone H, at Punta Blanca.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13724.**BURSIDAE*****Bursa nana*** Sowerby

Plate 5, fig. 6.

*Occurrence*.—Jama formation, Puerto Jama.***Bursa (Crossata) ventricosa*** Broderip

One small shell.

*Occurrence*.—Canoa formation, Punta Blanca.**CYMATIDAE*****Cymatium wiegmanni*** Anton

Plate 7, fig. 1.

*Occurrence*.—Canoa formation, Punta Blanca.

***Distorsio decussatus* (Valenciennes)**

Plate 5, fig. 9.

*Tritonium decussatum* Valenciennes, 1832, Humboldt and Bonpland, *Recueil Obs. Zool.* vol. 2, p. 306.

It has been commonly believed that but one *Distorsio* was found living in the Panama Province but actually there are 2 well-marked species, *Distorsio decussatus* Val., described from Acapulco, and *Distorsio constrictus* Broderip, described from Santa Elena, and well figured by Reeve, (1844, *Conch. Icon., Triton*, pl. 12, fig. 41). The 2 species are easily separated even when they occur together, as they do at several places along the Ecuadorian and Panamic coast. *Distorsio constrictus* is a strongly distorted shell, the aperture and particularly the inner lip being strongly tuberculate with a short but strongly recurved anterior canal. *Distorsio decussatus* is a more slender, regular and thinner shell; the parietal callus is smoother, and the anterior canal is longer and nearly straight. In both species the spiral cord on the shoulder or periphery of the body-whorl is doubled. A recent specimen of *Distorsio constrictus* from Manta, Ecuador (pl. 5, fig. 12) is figured for comparison with *decussatus*.

In case of most fossil specimens and even among some of the recent *decussatus*, the anterior canal appears short, having been broken or worn away. The relations of these shells to *decussatus* can then be seen in the features of the aperture, an important character being the 2 strong, plait-like lirae situated on the inner lip at and near the posterior canal, one emerging to the angle, the other more receding. In *constrictus* only the lower of these plaits is present, the upper one being replaced by several wart-like tubercles.

*Occurrence*.—Jama formation, Puerto Jama. Canoa formation, Punta Blanca.

**CASSIDIDAE*****Semicassis centiquadrata* (Valenciennes)**

Plate 8, fig. 2.

*Cassis centiquadratus* Valenciennes, 1832, *Recueil d'Obs. Zool.*, Humboldt et Bonpland, vol. 2, p. 310 (Acapulco).

*Cassis abbreviata* Lam., Reeve, 1848, *Conch. Icon.*, vol. 5, pl. 8, fig. 18a (not 18b). (Acapulco). Not of Lamarck.

As *Semicassis centiquadrata* occurs commonly along the Pacific coast of northern South America it is usually a plainly sculptured shell with only a single row of small nodes around the shoulder of the last whorl. More rarely, a second row of nodes may also be developed, as in typical *centiquadrata*, and the sculpture over the whole shell is coarser. In the 2 fossil specimens from Punta Blanca, these characters of coarser sculpture are more strongly developed than in any recent examples seen. The shell is heavy, the shoulder with strong tubercles, and with 2 tuberculose girdles below it, smooth spaces between them. Below this the spirals are wide,

flat and smooth, about 9 in number below the last tuberculose band. They are separated by shallow linear grooves. The shell figured measures 47 mm. long, 37 mm. wide.

*Occurrence*.—Canoa formation, Punta Blanca.

The fossil specimens show no varices preceding the terminal one. In recent shells there is sometimes a varix on the penult whorl, but it is exceptional.

Owing to Reeve's identification of this west coast species with the West Indian *Cassis abbreviata* Lamarck, it has usually been referred to under that name.

**Semicassis centiquadrata** variety

Plate 7, figs. 3, 6.

*S. centiquadrata* is a multiform species, like *S. gibbus* in the Gulf of Mexico, and possibly some division into local subspecies may be made. The Puerto Jama specimens (figs. 3, 6) contrast strongly with those of Punta Blanca, having the nodules reduced to a single row of small ones at the shoulder. Below it are about 13 wide, flat, equal bands, separated by slight ledges rather than grooves. Above the shoulder are 4 unequal bands, which are crossed by indistinct axial waves. On the earlier whorls the spirals are more cord-like and the axial sculpture of fine, narrow riblets is strongly developed. Apertural characters are those of *centiquadrata*.

Length 43 mm., diameter 34 mm.

*Occurrence*.—Jama formation, Puerto Jama. A.N.S.P. 13663.

Some specimens have a varix on the penult whorl, as in some examples of the West Indian *S. gibba* (Gmel.), with which this West Coast fossil has much in common.

**TONNIDAE**

**Malca ringens** Swainson

*Occurrence*.—Jama formation, Puerto Jama.

**FICIDAE**

**Ficus ventricosa** Sowerby

*Occurrence*.—Jama formation, Puerto Jama. Canoa formation, Punta Blanca.

**CYPRAEIDAE**

**Cypraea cayapa** new species

Plate 7, fig. 4.

The shell is large, solid, semiglobose with the spire completely concealed. The back or dorsal side is strongly convex, broadly but indistinctly humped in the middle of the back; on the posterior slope with 2 low but wide tubercles. The base is somewhat flattened. Aperture narrow, the outer and inner lips bearing coarse, plait-like teeth. Anterior end not known.

Faint, brown radial lines extend across the sides of the shell, fading out toward the top.

Length 62 mm. (imperfect), width 61.5 mm., height 42.5 mm. Type.

This *Cypraea* is represented by one specimen which is imperfect, having lost the anterior end, and the aperture is partly filled with matrix which cannot be removed. Before being entombed in the sediments, the shell had been eaten into by boring organisms and partly encrusted with a growth of bryozoa so that it is possibly a shell derived from an older fossiliferous series. When complete, the shell probably had a length of about 85 mm.

*Cypraea cayapa* belongs to the group of *C. henekeni* Sowerby, of the Santo Domingo and Panama Miocene. A smaller, undescribed species occurs in the Miocene of the Rio Santiago, northern Ecuador, but none are known in the present West Coast fauna.

According to Schilder's arrangement, this species would be a *Siphocypraea*.

*Occurrence*.—Jama formation, Puerto Jama. Type A.N.S.P. 13665.

#### CERITHIIDAE

*Cerithium stercusmuscarum* Valenciennes

*Occurrence*.—Jama formation, Puerto Jama. Canoa formation, Punta Blanca.

#### TURRITELLIDAE

*Turritella pasada* new species

Plate II, figs. 3, 4.

Shell large, with numerous, regularly tapering whorls, bluntly angular at the periphery, which is situated just above the lower suture; whorls 17 or more, the largest specimen being not entirely complete; nucleus unknown; the earlier post-nuclear whorls have about 5 spiral threads which alternate in strength, and between them there is a single very small secondary thread; on the later whorls the primaries increase so that on the penult whorl there are 9 or 10 while their interspaces widen and have 2, 3 or even more finer secondary and even tertiary threads; the periphery of each whorl is wider than the posterior edge of the next, so that it distinctly overhangs it and the suture; base of last whorl more or less flattened, sculptured with fine, unequal spiral threads. Aperture obliquely subquadrate, the outer lip obliquely retractive. The lines of growth show that it forms a wide, shallow bay in the peripheral region.

Length 108 mm., diameter 23 mm. Type.

This is a very characteristic species of the Pliocene beds of Puerto Jama, occurring as far south as Cabo Pasados, but it has not been found at Punta Blanca. It is nearly related to the recent *T. tigrina* Kiener, known only as far south as Panama, but the fossil form differs by its more uniform and finer spiral sculpture. It is also less attenuate in the upper part.

*Occurrence*.—Jama formation, Puerto Jama. Type A.N.S.P. 13682.

*Turritella broderipiana* d'Orbigny

The Upper Miocene form of this species, as it occurs in the Tumbes beds of northern Peru, was described as *T. plana* by Nelson, later changed on account of a prior use of this name, to *alturana* by Spieker (see Olsson, 1932, *Bulls. Amer. Paleontology*, vol. 19, no. 68, p. 204). The fossil shells are, however, so close to the recent species that they cannot be consistently separated.

*Occurrence*.—Canoa formation, Punta Blanca.

## CAECIDAE

*Caecum (Quadrulata) campe* new species

Plate 10, figs. 7, 8.

The shell is moderately curved, less in the larger half, at the anterior end slightly swollen and then contracted to the aperture. Septum produced in a rather long, slender spur placed near the right dorsal side. Sculpture of about 25 narrow riblets parallel to the length, and very numerous, delicate rings, which are distinct only on the apertural fourth of the length or less, elsewhere being very fine and often hard to see.

Length 5.5 mm., diameter near aperture 1 mm. Type.

This species belongs to the Section *Quadrulata* de Folin (*Les Méléagrines*, p. 46, 1867), the type of which we take to be *Caecum heptagonum* Carpenter, as this was redefined by de Folin. The group *Elephantanellum* Bartsch (*Journ. Wash. Acad. Sci.*, vol. 10, p. 566, 1920), appears to be identical with *Quadrulata*.

*C. campe* is much larger than the Panamic *C. laqueatum* C. B. Ad., and may be more nearly related to the Californian "*Elephantanellum*" *carpenteri* Bartsch, which has not been figured or fully described.

In this connection it may be mentioned that Oldroyd (*Marine Shells of the West Coast of North America*, vol. 2, pt. 3, p. 46) quoted Bartsch's definition and type of *Elephantanellum* for *Elephantulum* Cpr.

*Occurrence*.—Canoa formation. Type A.N.S.P. 13725.

## SOLARIIDAE

*Architectonica (Architectonica) sexlinearis* (Nelson)

*Solarium sexlineare* Nelson, 1870, *Trans. Conn. Acad. Sci.*, vol. 2, p. 194, pl. 6, fig. 11.

*Solarium sexlineare* Grzybowski, 1899, *Neues Jahrb. f. Min. etc., Beil. Bd.*, vol. 12, p. 642, pl. 20, fig. 13.

*Solarium sexlineare* Woods, 1922, *Bosworth, Geology of North-West Peru*, p. 109, pl. 18, figs. 1a, 1b, 1c.

*Architectonica (Architectonica) sexlinearis* Olsson, 1932, *Bulls. Amer. Paleontology*, vol. 19, pp. 213, 214, pl. 21, figs. 7, 10.

This species has been known hitherto only from the Miocene of northern Peru, where it occurs in the Cardalitos and Tumbes formations. It is easily distinguished from the *nobilis* group (*granulata* Lamarck) by its large, smooth peripheral cord, which in *nobilis* is quite small, so that the edge of



the whorl is sharp and often more or less overhanging. The spirals on the basal and upper surface of the last turn are wider, fewer in number and more nearly equal in size.

*Occurrence*.—Jama formation, Puerto Jama.

**Architectonica (Architectonica) granulata** Lamarck

*Occurrence*.—Canoa formation, Punta Blanca.

### RISSOIDAE

**Onoba fortis** new species

Plate 8, fig. 3.

The shell is subrimate, ovate with rather long spire, stout in figure for a shell of this genus. First  $3\frac{1}{2}$  whorls are convex, smooth, spirals beginning faintly on the penult whorl. The last whorl is evenly sculptured with about 25 low, rounded spiral cords, parted by narrower interstices, those below the periphery a trifle more prominent than the upper ones. The ovate aperture is obtusely angular posteriorly, the peristome being somewhat thickened throughout. Columella concave, a narrowly lunate flat area behind it, below the axial rimation.

Length 3.8 mm., diameter 1.9 mm.;  $5\frac{1}{2}$  whorls. Type.

This is rather stout in figure for a shell of this genus.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13688.

### CALYPTRAEIDAE

**Crucibulum (Dispotaea) imbricatum** Sowerby

*Calyptraca imbricata* Broderip, 1833, Trans. Zool. Soc. London, vol. 1, p. 198, pl. 27, fig. 7.

The recent species occurs along the coast of Ecuador. These shells are very similar to Broderip's figure referred to above. It has the cup of *Dispotaea*, adherent widely by one side to the interior of the shell. It is generally a light-colored shell. The fossils are similar to recent specimens but larger. The *Crucibulum* (*Crucibulum*) *rude* Broderip, the larger, more common species in the recent Ecuadorian fauna, has not been found fossil.

*Occurrence*.—Canoa formation, Punta Blanca. Jama formation, Puerto Jama.

**Crucibulum (Dispotaea) inerme** Nelson

Plate 7, fig. 2.

*Crucibulum inerme* Nelson, 1870, Trans. Conn. Acad. Sci., vol. 2, p. 188.

*Crucibulum (Dispotaea) inerme*, Olsson, 1932, Bulls. Amer. Paleontology, vol. 19, pp. 212, 213, pl. 24, figs. 4, 7.

We have a few specimens of this species from Punta Blanca. The interior is exposed, showing the cup of *Dispotaea*. The exterior is smooth except for a group of small riblets at the posterior end.

Greater diameter 32.8 mm.

*Occurrence*.—Canoa formation, Punta Blanca.

**Crucibulum (Crucibulum) hispidum** Broderip

*Occurrence.*—Canoa formation, Punta Blanca.

**Crucibulum alloglyptum** new species

Plate 7, fig. 5.

The shell is large, conic, the height nearly half of the length. Upper part of the cone is nearly smooth; then fine radial riblets appear on both right and left sides, but more fully developed on the left side; they are rounded, crowded, about equal to their intervals. Later these riblets disappear, or are partly continued in the later sculpture, which consists of sharp, high, radial ribs, of which there are about 31. Their concave intervals are somewhat pitted transversely, or in places show short, irregular radial wrinkles. The sculpture described is interrupted by a wedge-shaped segment from apex to anterior margin where the surface is smoothish, with only some slight traces of radial cords. The inner margin is denticulate. The cup is broadly adnate by its whole right side.

Height 24 mm., greater diameter 52 mm., lesser diameter 40.5 mm. Type.

In a large series of *Crucibulum imbricatum* Sowerby, both recent and fossil, we have seen no specimens similar to the above described species, which differs by various details of sculpture and particularly by the smooth area along the anterior slope.

The form and sculpture of *Crucibulum* is modified to a certain extent by the irregularities of the surface upon which they rest, but the differences in character between *alloglyptum* and *imbricatum* do not seem to be of this kind.

*Occurrence.*—Canoa formation, Punta Blanca. Type A.N.S.P. 13661.

**NATICIDAE****Natica broderipiana** Recluz

*Occurrence.*—Canoa formation, Punta Blanca.

**Natica elenae** Recluz

*Natica broderipiana* and *elenae* have a similar sculpture of widely spaced axial lines, and fossil shells of the 2 species are often difficult to separate. The color patterns are very different, that of *elenae* consisting of closely crowded, wavy brown lines over the whole shell, while that of *broderipiana* has a set of 3 rows of large brown spots revolving around the shell. These color markings are frequently preserved in the fossils. The umbilical cord of *elenae* is generally larger than in *broderipiana*.

*Occurrence.*—Canoa formation, Punta Blanca.

**Natica marochiensis** Gmelin

*Occurrence.*—Jama formation, Puerto Jama.

**Natica unifasciata** Lamarck

As fossil, this species is difficult to separate from the preceding, but the tangential lines around the suture are more irregular in their distribution.

*Occurrence*.—Canoa formation, Punta Blanca.

**Polinices panamensis** Recluz

This species is very common at Punta Blanca. Shells from Puerto Jama have a higher spire and the body-whorl is therefore less quadrate or shouldered in profile. *Polinices subangulata* Nelson from the Tumbes beds of northern Peru can scarcely be distinguished from the recent species.

*Occurrence*.—Jama formation, Puerto Jama. Canoa formation, Punta Blanca.

**Polinices** species undermined

To this species, we are referring a number of shells usually quite small, distinguished from the preceding by their high, blunt spire, strongly appressed sutures between more or less distinctly swollen whorls, and thick parietal callus, transversely grooved in the middle. Young shells of *panamensis* may be quite similar but they have a lower, more regularly formed spire, smaller umbilicus and generally absence of a deep parietal groove.

*Occurrence*.—Canoa formation, Punta Blanca.

**Polinices rapulum** Reeve

Our shells from Puerto Jama agree quite well with Reeve's figure of this species from Payta. It is distinguished by its high spire and strong umbilical cord.

*Occurrence*.—Jama formation, Puerto Jama.

**TURBINIDAE****Turbo (Callopoma) saxosus** Wood

One specimen only.

*Occurrence*.—Canoa formation, Punta Blanca.

**TROCHIDAE****Calliostoma nonurum** new species

Plate 8, figs. 7, 10, 11

Shell imperforate, conical, of about 7 whorls; nucleus very small; each whorl has a wide, shallow or flat channel which is situated just above the periphery on the last whorl, so that the coiling follows along the blunt lower or peripheral keel; the earliest post-nuclear whorls have 3 beaded spirals which increase rapidly in number on the succeeding turns but soon become obsolete so that the later turns are practically smooth except for the weak, strongly retractive lines of growth; base flattened or very slightly convex, sculptured generally with 2 to 4 smooth or feebly wrinkled spirals around the axial callus, fading out towards the periphery; pillar concave above, thickened, with a blunt prominence at the base; aperture subtrapezoidal, smooth inside.

Height 25.9 mm., diameter 29.3 mm. Type.

Height 22.9 mm., diameter 26 mm.

This fine species, recognized by its doubly keeled and channelled peripheral region and smoothish sculpture, is fairly common in the Pliocene beds at Punta Blanca. We have also 2 recent specimens collected at Nonura Bay, northern Peru. These recent shells are colored with a series of revolving, narrow, purple and white lines on a white or light ground. On the base these lines number about 5, are rather widely spaced, but become more numerous on the upper part of the shell, imparting a general purplish color. *C. palmeri* Dall is a strongly granose recent species of similar form.

*Occurrence*.—Punta Blanca beds. Type A.N.S.P. 13685.

#### VITRINELLIDAE

*Teinostoma ecuadorianum* new species

Plate 9, fig. 1.

The imperforate shell is moderately depressed, with convex spire and rounded periphery, the surface smooth, but showing very minute, close growth lines on the upper face. The spire is narrow, composed of slightly over 3 flat whorls which meet in a very superficial suture (exaggerated in the figure, being actually so closely appressed that it is difficult to trace it in some places). The aperture is rounded outwardly; the parietal margin straight and bordered by a callous band. The umbilical region is filled evenly with a smooth callous pad.

Height 0.9 mm., diameter 2 mm. Type.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13731.

According to the figure of H. & A. Adams, the type of *Teinostoma* has the spire exposed, though rather narrow. The nucleus is not "concealed by overlap of later whorls," as has been stated; that condition being characteristic of *Idioraphe*. The species described above appears to be properly referable to *Teinostoma*.

*Pseudorotella lens* new species

Plate 9, fig. 2.

The shell is rimate, lens-shaped, of nearly  $3\frac{1}{2}$  whorls, those of the convex spire being smooth, the last one widening rapidly, acutely keeled at periphery, with a low cord above the keel, a much smaller one above it; below the keel there is another cord separated by a small smooth interval. The aperture is rounded, the columellar lip with a broad, flattened area occupying a callus which almost closes the umbilical cavity.

Height 0.7 mm., diameter 1.8 mm. Type.

A second, broken specimen is somewhat larger. The shell is *Teinostoma*-like, with the spire wholly exposed, with distinct but shallow suture; the columella is backed by a heavy callus almost filling the umbilical region. The species has a peripheral keel and several spiral threads adjacent to it.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13732.

**Circulus occidentalis** new species

Plate 9, fig. 3.

The minute shell is openly umbilicate, nearly flat above, the first whorl projecting slightly. There are  $3\frac{1}{2}$  whorls, the first  $2\frac{1}{2}$  smooth, rounded, a keel then appearing on the upper surface. The last whorl has also another less prominent keel at the shoulder, a keel at the base, and 2 or 3 smaller spirals around and in the umbilicus. The last whorl increases rapidly. The large, irregularly rounded aperture is strongly oblique. The peristome is interrupted at the parietal wall, the upper margin being arched strongly forward.

Height 0.9 mm., diameter 1.5 mm. Type.

Occurrence.—Canoa formation, Punta Blanca. Type A.N.S.P. 13733.

It resembles *C. pentagonus* Gabb in general form but the aperture and umbilicus differ.

**SYSTELLOMPHALUS** new genus

The shell is depressed, openly umbilicate, the umbilicus with a heavy overhanging margin. Aperture shaped much as in *Circulus*, the parietal margin short, upper margin of the lip somewhat arching forward.

Genotype.—*Systellomphalus perornatus* new species.

**Systellomphalus perornatus** new species

Plate 9, fig. 4.

The depressed, openly umbilicate shell of 4 whorls has the periphery angular, but becoming rounded in the last part. The penult whorl is sculptured with retractively radial low riblets, but these almost wholly disappear on the last whorl. On the base there are several spiral cords at and below the periphery, and a few impressed radial lines. The irregular margin of the umbilicus overhangs the cavity, which is much enlarged in the last whorl. The aperture is irregularly rounded, the peristome simple, continued in a short, rather heavy parietal callus.

Height 1.2 mm., diameter 1.8 mm. Type.

Occurrence.—Canoa formation, Punta Blanca. Type A.N.S.P. 13730.

Only a single broken specimen of this characteristically sculptured little shell was found. The overhanging border of the umbilicus is a peculiar feature. It is obviously not a *Circulus*, but in the present condition of the system we are unable to suggest any established genus which will admit it.

**SCAPHOPODA****DENTALIIDAE****Dentalium** (Tesseracme) *tesseragonum* Sowerby

Occurrence.—Canoa formation.

**SIPHONODENTALIIDAE****Cadulus** (Polyschides) *quitus* new species

Plate 10, figs. 9, 10.

The shell is rather large, well curved, smooth and glossy. The greatest diameter, near the oral third, is contained about 5.5 times in the length.

The aperture is rather strongly oblique, slightly longer than wide. Anal orifice thin-edged, with 4 shallow notches, and 4 teeth (which are probably somewhat worn), that on the convex side wider than the others.

Length 5.6 mm., greatest antero-posterior diameter 1 mm. Type.

This species resembles *Cadulus quadrifissatus* Pilsbry, of California, but in that species the aperture is somewhat wider relative to the length, the apical slits are longer, the teeth all more conspicuously bevelled. Our shell is also smaller.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13719.

***Cadulus (Gadilopsis) leptodoma* new species**

Plate 10, fig. 11.

The shell is not much curved, long and very slender, the greatest diameter contained about 11 times in the length. The diameter increases rather slowly to the middle, and thence very slowly nearly to the aperture, then tapering rather rapidly to the aperture. The glossy surface shows no sculpture on the larger two-thirds, but the apical third is rather irregularly annulate, the corrugation rather weak. The aperture is oblique, a little wider than long.

Length 6.5 mm., greatest diameter 0.6 mm. Type.

The recent *C. panamensis* Pilsbry & Sharp tapers more regularly and rapidly from the swelling near the aperture to the apex. The present species tapers very little in the oral half of its length, much as in *C. fusiformis* Pilsbry & Sharp.

*C. perpusillus* (Sby) may prove to be the same as our species, but it cannot be identified at present, since the sculpture is unknown, and it has not been figured. It is a trifle larger than our fossil, the diameter contained 9 times in the length, according to the measurements assigned, which may not be exact (cf. Pilsbry & Sharp, 1898, *Man. Conch.* vol. 17, p. 190).

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13720.

## PELECYPODA

### NUCULIDAE

***Nucula exigua* Sowerby**

Common, also recent.

*Occurrence*.—Canoa formation, Punta Blanca.

***Nucula declivis* Hinds**

Less abundant than the preceding.

*Occurrence*.—Canoa formation, Punta Blanca.

***Nucula* species undetermined**

One specimen from the *Loripes* zone.

*Occurrence*.—Canoa formation, Punta Blanca.

### NUCULANIDAE

#### *Nuculana gibbosa* Sowerby

This elegant species is distinguished by its large size, sharp, neat sculpture and absence of a lunule. *Leda acuminata* Nelson 1870 (not von Buch 1845), renamed *Leda peruviana* by Dall, from the Tumbez beds of northern Peru, is the same species. This species also occurs recent.

*Occurrence*.—Canoa formation, Punta Blanca.

#### *Nuculana eborea* Sowerby

Smaller than the preceding species and distinguished by its finer sculpture and by its narrow, strongly marked lunule. This recent species occurs also in the Tumbez beds of Peru.

*Occurrence*.—Canoa formation, Punta Blanca.

#### *Nuculana elenensis pyriformis* Broderip & Sowerby

This is probably a valid species, always quite small, pointed, with a distinct, indented anterior ray and a small, narrow, sculptured lunule. Common.

*Occurrence*.—Canoa formation, Punta Blanca.

### ARCIDAE

#### *Barbatia (Acar) gradata* Broderip & Sowerby

*Occurrence*.—Canoa formation, Punta Blanca.

#### *Noetia (Noetia) reversa magma* MacNeil

*Arca (Noetia) reversa* Gryzbowski, 1899, Neues Jahrb. f. Min. etc., Beil. Bd., vol. 12, p. 634, pl. 17, figs. 1, 1a (not of Sowerby).

*Arca (Noetia) reversa* Sowerby ——— subsp., Olsson, 1932, Bulls. Amer. Paleontology, vol. 19, pp. 77, 78, pl. 3, fig. 1.

*Noetia magma* MacNeil 1938, U. S. Geol. Survey, Prof. Paper 189-A, p. 38, pl. 6, figs. 20, 21.

Recent specimens of *Noetia reversa* Sowerby are fully mature when they have attained a length of 45-50 mm., as shown by the crowding of the posterior set of hinge teeth, but larger specimens have not been seen. Fossil Noetias of this size from the Upper Miocene and Pliocene beds of Peru and from Puerto Jama are immature and the teeth of the posterior set are long and narrow in form. Fully grown shells from Jama have a length of 70 mm., height 58 mm. and examples from Peru are often larger, 80 mm. The name *Noetia magma* was given by MacNeil to the large *Noetia* figured by Gryzbowski as *reversa*, from the Mancora tablazo beds at Paíta, of Late Pliocene age, the type specimens being preserved in the Geological Institute of the Jagiellonian University, Krakow, Poland. A single valve measuring length 65 mm., height 60 mm., and semidiameter 37 mm. is in our collections from the Pleistocene of the Burica Peninsula of western Panama.

*Occurrence*.—Jama formation, Puerto Jama. Pliocene of Puna Island.

***Arca (Scapharca) concinna* Sowerby**

This species is common in the Pliocene beds of Ecuador although it appears to be rare in the recent fauna. It is easily distinguished by its lengthened form and numerous, plain or usually undivided ribs. Average length about 35 mm.

*Occurrence*.—Jama formation, Punta Cabuyal. Canoa formation, Punta Blanca.

***Arca (Scapharca) obesa* Sowerby**

Common as a fossil at Puerto Jama and in the recent fauna along the Ecuadorian coast.

*Occurrence*.—Jama formation, Puerto Jama, Punta Cabuyal.

***Arca (Scapharca) hopkinsi* new species**

Plate 11, figs. 1, 2.

Shell large, inflated, strongly convex, squarish in outline, with the length a little longer than the height, and highest at the posterior third; the anterior side is obliquely rounded towards and into the ventral margin, while the posterior side is truncate, nearly straight, at right angles to the long, straight hinge-line; umbones full, passing forward into the very small, prosogyrate beaks which are situated at the anterior third; the shell is strongly and evenly convex, with the posterior-dorsal extremity appearing slightly depressed or flared-out; left valve with about 38 ribs which are somewhat wider on the anterior side and separated by nearly smooth interspaces, narrower than the ribs; the ribs are corded or sculptured with irregular threads, 4 or 5 on each rib on the anterior side, about 4 to 7 on the posterior; the intercostal spaces are smoothish or have only very faint radial or concentric striae; the right valve is similar in sculpture; interior of valve deep, the ventral margin deeply fluted by the ends of the ribs; hinge straight with a continuous series of subvertical teeth of medium size, becoming decidedly larger near the posterior end; cardinal area that of *Scapharca*, fairly wide and grooved with 3 or 4 chevron-shaped lines.

Length 93 mm., height 85 mm., semidiameter 39 mm. Type.

This fine, large species is not closely related to any living or fossil ark known to us from this region. It resembles somewhat the *Arca veatchi* Olsson of the Caribbean Miocene, of which there is a representative species in the Miocene of Ecuador, the latter differing by its smaller size and more numerous ribs.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13683.

***Arca (Scapharca) wheeleri* new species**

Plate 13, fig. 3.

Shell large, transversely elongated and moderately convex; the left valve shows the following characters: the umbo is wide, with the small prosogyrate beak at the anterior third; the valve is quite strongly inflated across the umbo to the anterior third of the ventral margin; posteriorly the inflation



becomes less, with a rounded umbonal slope, the posterior-dorsal submargins being more strongly depressed; the anterior side slopes rapidly and develops the semblance of an indistinct sulcus or slight radial concavity. The interior of the shell has a slightly distorted or warped appearance, the ventral margin being obtusely angled a short distance anterior to the middle, corresponding to the zone of greatest inflation. The left valve has 33 ribs which are strongest in the middle of the shell, and flatten or fade out on the posterior-dorsal submargins; these ribs are smooth and have a faint depression along the middle; interspaces are as wide or slightly wider than the ribs; right valve is probably similar to the left. Hinge long, straight, with a continuous series of small teeth and a wide ligament area with about 7 lozenge-shaped lines.

Length 94 mm., height 64.5 mm., semidiameter 29 mm. Type.

Like the last, this ark has no closely related species in the known fauna of this region. Certain species such as *Arca actinophora* Dall of the Gatun Miocene and *Diluvarca strebla* Gardner of the Alum Bluff beds of Florida have a remote resemblance to our shell, because of their transverse outline and widely rounded ventral margin. The species is very rare, as only a single, fragmentary specimen, a left valve, was found.

*Occurrence*.—Canoa formation; Punta Blanca. Type A.N.S.P. 13667.

***Arca (Scapharca) ecuadoriana* new species**

Plate 13, fig. 1.

Shell of medium size, convex, subcircular to subquadrate in outline. Right valve has about 30 smooth, rather flat-topped ribs, 10 being situated on the anterior-dorsal end; the intercostal spaces are smooth, about equal to, or anteriorly slightly wider than, the ribs; umbones prominent, the beaks at about the anterior three-fifths of the length; dorsal-umbonal slope slightly convex, becoming a little excavated near the beak; cardinal area wide, marked with about 4 chevron-shaped lines, otherwise smooth; hinge-line straight, about three-fifths as long as the shell, with the teeth arranged in 2 sets, the anterior set with about 21 teeth, the posterior with 31; cavity of shell deep, the margins fluted by the ends of the ribs.

Length 48 mm., height 49 mm., semidiameter 24 mm. Type.

This species is known only from a single right valve. In external form it resembles some species of *Argina*, but has a high, grooved cardinal area. The ribs are worn.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13666.

***Arca (Cunearca) zorritensis* Spieker**

*Scapharca* sp. ind. Nelson, 1870, Trans. Conn. Acad. Sci., vol. 2, p. 205.

*Arca (Cunearca) zorritensis* Spieker, 1922, Johns Hopkins University, Studies in Geology, no. 3, p. 96, pl. 5, figs. 4, 5.

?*Arca (Scapharca) pantheonensis* Spieker, 1922, op. cit., p. 99, pl. 5, figs. 8, 9.

*Arca (Cunearca) zorritensis* Olsson, 1922, Bulls. Amer. Paleontology, vol. 19, pp. 70, 71, pl. 4, figs. 3, 5, 11.

We are referring to this species a number of shells from Puerto Jama. They differ from *Arca nux* Sowerby in being generally larger, with more

rounded outlines and wider, fuller umbones. In some of these characters the fossils seem closer to *Arca chemnitzii* Philippi of the Caribbean region.

*Occurrence*.—Jama formation, Puerto Jama.

***Arca (Cunearca) nux* Sowerby**

*Occurrence*.—Canoa formation, Punta Blanca.

***Arca (Cunearca) aequatorialis* d'Orbigny**

*Occurrence*.—Jama formation, Puerto Jama.

***Arca (Cunearca) labiata* Sowerby**

*Occurrence*.—Canoa formation, Punta Blanca.

***Arca (Cunearca) esmeralda* new species**

Plate 13, figs. 4, 5.

Shell rather large and moderately heavy, the valves with discrepant sculpture, the ribs of the right valve being strongly nodose throughout; the left valve is broadly quadrate in outline, a little longer than high, with the wide, full umbones situated a little in front of the middle and usually with a wide, depressed area extending from the beak to the posterior-ventral margin; in the left valve the ribs number about 28, of which the anterior 8 to 10 are quite strongly nodose, the others quite weakly nodose to nearly smooth; the ribs are separated by wider interspaces which are smoothish anteriorly, elsewhere marked with strong cross-striations and very weak radial threads; the right valve is perhaps a little heavier than the left, with the ribs strongly noded, separated by narrower intervals which are generally smoothish except on the posterior slope where they are strongly cross-hatched by close, concentric lines; umbones prominent, ending in the strongly prosogyrate beaks, situated near the front third of the length, and above a moderately wide, smooth cardinal area marked with about 2 sets of chevron-shaped grooves; hinge-line with a continuous row of teeth, smallest near the middle, slightly larger towards the ends, numbering in the right valve figured about 20 in the anterior set and 34 in the posterior, and in a left valve 18:28. Cavity of shell deep, with evident but scarcely sunken adductor scars, the margin deeply fluted by the ends of the ribs.

Length 57 mm., height 53 mm., semidiameter 25.5 mm. Type, right valve.

Length 50 mm., height 46.5 mm., semidiameter 22 mm. Left valve.

The sculpture of this species is that of *Cunearca* but the cardinal area is marked with strong chevron-shaped grooves and the shell is heavier and larger than typical for most species of this subgenus.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13668.

***Arca (Argina) brevifrons* Sowerby**

*Occurrence*.—Jama formation, Puerto Jama, Punta Cabuyal.

***Arca (Larkinia) larkinii* Nelson**

*Arca larkinii* Nelson, 1870, *Trans. Conn. Acad. Sci.*, vol. 2, p. 204, pl. 7, figs. 5, 6, 7.

*Arca (Scapharca ?) larkinii* Spieker, 1922, *Johns Hopkins University, Studies in Geology*, no. 3, p. 111, pl. 5, figs. 16-18.

*Arca* (*Senilia*) *larkinii* Olsson, 1932, *Bulls. Amer. Paleontology*, vol. 19, pp. 75, 76, pl. 2, figs. 1, 4, 5.

*Anadara* (*Larkinia*) *larkinii* Reinhardt, 1935, *Bull. Musée Roy. d'Hist. Nat. Belgique*, vol. 11, no. 13, p. 41, pl. 4, fig. 1.

This large, thick-shelled ark was previously known only from the Upper Miocene or Tumbes beds of northern Peru, where it is fairly common. Its discovery in the Pliocene of Ecuador is therefore of great interest as indicating the Tertiary age of these beds. Its form and thick shell is much like that of an immature *Arca grandis* Broderip & Sowerby, but the cardinal area is smooth and some of the ribs strongly nodose.

*Occurrence*.—Canoa formation, Punta Blanca.

***Glycymeris canoa* new species**

Plate 13, figs. 2, 2a.

Shell of medium size, solid, moderately inflated and nearly equilateral, the posterior side being a little wider than the anterior; when viewed from the inner side the anterior and posterior marginal slopes below the beaks are seen to be nearly straight, the ventral margin rounded. The small central beak is situated at the margin and but slightly projecting; the right valve has about 26 ribs which are large and rather strong but low in the middle, very small on the ends; the middle ribs are slightly squarish in form, flat-topped, and separated by intervals which near the ventral margin are a little wider than the ribs, and marked by lines of growth; hinge with the anterior and posterior sets of teeth separated by a smooth area, there being about 11 teeth on the posterior side and about 10 on the anterior side. Adductor scars distinct; the ventral margin with shallow flutings of the middle ribs; cardinal area widely triangular, striated.

Length 46 mm., height 50 mm., semidiameter 14 mm. Type.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13669.

***Glycymeris inaequalis* Sowerby**

*Occurrence*.—Canoa formation, Punta Blanca.

***Glycymeris maculata* Brod.**

*Occurrence*.—Canoa formation, Punta Blanca.

**OSTREIDAE**

***Ostrea megodon* Hanley**

*Occurrence*.—Jama formation, Puerto Jama. Canoa formation, Punta Blanca.

**SPONDYLIDAE**

***Plicatula dubia* Hanley**

One specimen.

*Occurrence*.—Canoa formation, Punta Blanca.

## PECTINIDAE

**Pecten (Plagiectenium) ventricosus** Sowerby

Common, and larger than most recent specimens.

*Occurrence*.—Jama formation, Puerto Jama. Canoa formation, Punta Blanca.

**Pecten (Plagiectenium) tumbezensis** d'Orbigny

*Occurrence*.—Canoa formation, Punta Blanca.

**Pecten (Plagiectenium) nelsoni** Olsson

First described from the Upper Miocene of Peru, this species was found to be quite common at Puerto Jama.

*Occurrence*.—Jama formation, Puerto Jama.

**Pecten (Janira) sericeus** Hinds (?)

Plate 19, fig. 1.

*Pecten sericeus* Hinds, 1844, Zool. Voy. Sulphur, Moll., p. 60, pl. 17, fig. 1.

We have fragments of both right and left valves of a large *Pecten* with low, narrow ribs separated by wide, concave intervals covered with fine, even, crowded concentric threads. This species seems to be *Pecten sericeus* Hinds, described from a single specimen dredged in the Bay of Panama. The shell is rather large, thin, the right valve being moderately convex while the left valve is flattened to slightly concave. Our specimens being imperfect, a correct count of the ribs is not possible, but the right valve seems to have had from 20 to 22 ribs. These ribs are narrow, triangular in section, between wide, concave intervals. In the left valve the ribs are narrow, broadly rounded, while their intervals are much wider. The entire surface is covered with fine, close-set and somewhat laminar concentric threads which become coarser and irregular ventrally. Anterior ear of the right valve and posterior ear of left valve smooth except for lines of growth, without ribs. Our shells being imperfect, accurate measurement of the size is not possible. An estimate of the size follows.

Height  $\pm 80$  mm., width  $\pm 90$  mm., semidiameter  $\pm 15$  mm., of a right valve. The greatest dimension of the fragment figured is 72.3 mm.

*Occurrence*.—Canoa formation, Punta Blanca.

## MYTILIDAE

**Crenella ecuadoriana** new species

Plate 18, figs. 2, 3.

Shell small, plump, oval. Valves nearly equilateral, with the prominent beaks turned a little anteriorly; sculpture composed of moderately fine radials, additional ones introduced occasionally between them; there are fine, concentric lines which cut the radials into low tubercles. Valve cavity rather deep, margin finely denticulated all around; hinge normal.

Height 3.3 mm., width 2.5 mm., semidiameter 1.20 mm. Type.

Height 3.6 mm., width 2.6 mm., semidiameter 1.1 mm.

Although previously undescribed, this species is locally fairly common along the Ecuadorian coast, but the recent shell is usually smaller than the fossil. It resembles closely the small East Coast Miocene species known as *C. dupliniana*, but an actual comparison of specimens has not been made. It has the outline of *C. diuturna* Pilsbry & Johnson of Santo Domingo.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13705.

#### ANOMIIDAE

*Anomia peruviana* d'Orbigny

*Occurrence*.—Jama formation, Puerto Jama. Canoa formation, Punta Blanca.

*Placunanomia cumingii* Broderip

This species is living along the Ecuadorian coast. It is locally fairly common as a Pleistocene fossil at Jaramijo and at some other localities.

*Occurrence*.—Jama formation, Puerto Jama. Canoa formation, Punta Blanca.

#### PERIPLOMATIDAE

*Periploma planiuscula* Sowerby

In the upper layers at Puerto Jama.

*Occurrence*.—Jama formation, Puerto Jama.

#### CRASSATELLITIDAE

*Eucrassatella gibbosa tucilla* (Olsson)

This subspecies occurs in the Upper Miocene of Peru and at Punta Blanca. From typical *E. gibbosa* it differs by its much larger size (length 70 mm., height 56 mm.), and less pointed, posterior extremity.

*Occurrence*.—Canoa formation, Punta Blanca.

*Crassinella pacifica* C. B. Adams

Shell of the average size for the genus, subtrigonal, more or less compressed, solid and coarsely sculptured over the whole surface. The beaks are placed a little anterior of the middle, somewhat curved forwards and pointed. Lunule narrow, elliptical.

*Occurrence*.—Canoa formation, Punta Blanca.

*Crassinella clementia* new species

Plate 12, fig. 8.

Shell of average size, *Astarte*-like in shape, compressed, fairly solid and with sculptured umbones, rest of surface smooth; beaks at the anterior third; ventral margin well-rounded, the postero-dorsal outline a little convex, the anterior end straight; sculpture consists of a series of very low concentric waves near the beaks, to the number of about 10; with the rest of the surface smooth except for faint lines of growth; lunule narrowly

elliptical, nearly as long as the anterior side; escutcheon smaller, narrowly elliptical. Ventral margin smooth.

Length 4 mm., height 3.6 mm., diameter 1.6 mm. Type.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13714.

***Crassinella haylocki* new species**

Plate 18, figs. 7, 8.

Shell very small, trigonal, solid with nearly smooth surface; the beaks are central or nearly so, erect or only slightly tilted anteriorly; the ventral margin usually evenly rounded with the anterior and posterior sides straight and of equal length; the sculpture is nearly smooth over most of the surface or developing a few, scattered, irregular growth-lines on the sides; the umbones are smoothish or show a series of small, crowded, concentric riblets.

Length 2.6 mm., height 2.5 mm., semidiameter 0.6 mm. Type.

Length 3 mm., height 2.75 mm., semidiameter 0.75 mm.

Easily recognized by its small size, trigonal form and smooth surface.

*Occurrence*.—Canoa formation, Punta Blanca.

**LUCINIDAE**

***Loripinus (Pegophysema) spherica* Dall & Ochsner**

*Lucina spherica* Dall & Ochsner, 1928, Proc. Calif. Acad. Sci., Ser. 4, vol. 17, pp. 121, 122, pl. 3, fig. 8, pl. 4, figs. 2, 7.

This species, first described from the Pliocene of Indefatigable Island (Santa Cruz), of the Galapagos, is very abundant and characteristic of Zone H at Punta Blanca. The shells are frequently found with the valves tightly closed and empty within.

*Occurrence*.—Canoa formation, Punta Blanca.

***Lucina (Bellucina) cancellaris* Philippi**

Quite common. It is living along the present coast.

*Occurrence*.—Canoa formation, Punta Blanca.

***Lucina (Parvilucina) callosana* new species**

Plate 18, fig. 6.

Shell very small, subcircular, and very plump; umbones about central, wide and full, the small beaks prosogyrate and placed at the anterior third. The surface sculpture consists of crowded, raised, concentric threads which are rough in appearance but are quite evenly spaced; a posterior area is limited by the end of the concentric threads which become alternately sharp and shortly spiniferous; at the upper side of the dorsal area there is another spiniferous ridge, the space between being more or less depressed and smooth or with weaker sculpture. Radial sculpture appears to be absent. Lunule small, shortly oval, and deep; hinge normal with 2 strong, lateral teeth. Margins minutely crenulated.

Length 2.8 mm., height 2.7 mm., diameter 2 mm. Type.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13706.

**Lucina (Luciniscia) liana** Pilsbry

*Phacoides (Luciniscia) liana* Pilsbry, 1931, Proc. Acad. Nat. Sci. Phila., vol. 83, p. 435, pl. 41, fig. 3.

The figure of "*Lucina muricata* Chemnitz", figured by Reeve in the Conchologica Iconica, pl. 8, fig. 46, from Santa Elena, represents this species. It is quite common in the recent fauna, ranging from Tumbes in northern Peru to southern Panama (Bucaru, Los Santos). It is fairly common in Zone H at Punta Blanca.

*Occurrence*.—Canoa formation, Punta Blanca.

**Lucina (Luciniscia) fausta** new species

Plate 17, figs. 3, 6.

Shell of medium size, subcircular, weakly convex; beaks small, pointed, and placed a little in front of the middle line of the shell; dorsal area marked off from the rest of the surface as a slightly depressed area; anterior end evenly rounded, the posterior end truncate. Surface is sculptured with fine radial threads and thin concentric threads producing a finely cancellated appearance, somewhat coarser and a little irregular at the ends; lunule small, linear, a little larger in the left valve. Hinge with strong lateral teeth in each valve, doubled at the ends. One cardinal tooth in the right valve and 2 in the left. Valve margins finely crenulated.

Length 33 mm., height 31 mm., semidiameter 6.7 mm. Type.

Length 25 mm., height 22.7 mm., semidiameter 5 mm.

Distinguished by its large size and regularly cancellated sculpture, the concentric and radial threads being of about equal strength. *Luciniscia fenestrata* Hinds approaches our species in size, but judging by Hinds' figure (Zoology of the Voyage of the Sulphur, Moll., pl. 19, fig. 2) it has stronger and more irregular radials, and the shell is more circular in form.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13708.

**Divaricella lucasana** Dall & Ochsner

*Lucina eburnea* Reeve, 1850, Conch. Icon., *Lucina*, fig. 49 (not *L. eburnea* Deshayes).

*Divaricella lucasana* Dall & Ochsner, 1928, Proc. Calif. Acad. Sci., ser. 4, vol. 17, p. 122, pl. 2, figs. 17, 21, 24.

Quite common, and as a recent species ranging from northern Peru to Cape San Lucas.

*Occurrence*.—Canoa formation, Punta Blanca.

**CARDIIDAE****Cardium (Trachycardium) ballenium** new species

Plate 12, fig. 9.

Shell large, moderately thin, inflated; umbones very wide, central, with small beaks; the right valve has 48 ribs in all, 10 being on the posterior area; on the middle of the shell the ribs are wider than their intervals, square or rounded on top, becoming broadly triangular on the anterior end; the top of each rib carries small, sharp, spike-like nodes at regular intervals; on the anterior side of the shell these nodes become larger and tile-shaped; on the sides of the ribs toward the anterior end there are very minute grains.

Ribs on the posterior area are low, bifid, the outer riblet spiniferous, the scarcely lower interspace being smooth. The interstices between the main ribs are deep, narrow, flat-bottomed grooves, smooth or marked only with fine, transverse striae. Hinge of left valve with a large, hook-shaped cardinal tooth, a small posterior lateral, and a large anterior lateral more distantly situated. Valve cavity deep, the margin fluted by the ends of the ribs; that of the posterior end being deeply toothed. There is a rather large, smooth, heart-shaped lunular area with a smaller, circular, smooth plate or flap of the dorsal margin, situated immediately beneath the beak.

Height 77 mm. (imperfect), length 82 mm., semidiameter 37 mm. Type.

This fine *Cardium* is quite common at Puerto Jama but always in a fragmentary condition. It has a strongly inflated shell with many fine ribs bearing prickles.

*Occurrence.*—Jama formation, Puerto Jama. Type A.N.S.P. 13711.

***Cardium (Trigoniocardia) cabopasadam* new species**

Plate 12, figs. 6, 7.

Shell obliquely oblong, strongly convex, the umbones full, beaks small, closely adjacent. The greatest inflation of the shell lies a little above the middle. Sculpture of about 23 ribs, there being 14 anterior to the umbonal angle and 9 on the posterior-dorsal slope; the main ribs are triangular in section, the top a little flat, and are parted by channelled intervals of the same width; the summits of the ribs bear transverse tubercles except on the umbones. The intercostal spaces are strongly cross-striated by raised threads; the dorsal-posterior ribs are smaller and flatter, with smaller tubercles than the middle ribs. Interior of shell thick, the edges fluted by the ends of the ribs. Hinge provided with strong teeth.

Greatest (oblique) height 38 mm., width (at right angles to preceding), 26 mm., semidiameter 15.5 mm. Type.

Greatest (oblique) height 33 mm., width 24 mm., semidiameter 14 mm.

This *Trigoniocardia* is interesting because of its large size. The distribution of the tubercles on the back of the ribs appears to have been variable; in some shells they are strongly developed while in others large parts of the ribs are smooth.

*Occurrence.*—Jama formation, Puerto Jama.

***Cardium (Trigoniocardia) spiekeri* Hanna and Israelsky**

*Hemicardia affinis* Nelson, 1870, Trans. Conn. Acad. Sci., vol. 2, p. 204 (not Münster, 1835).

*Cardium (Trigoniocardia) affinis* Spieker, 1922, Johns Hopkins University, Studies in Geology, no. 3, p. 136, pl. 8, fig. 2.

*Cardium spiekeri* Hanna & Israelsky, 1925, Proc. Calif. Acad. Sci., ser. 4, vol. 14, p. 62 (new name for *affinis* Nelson).

*Cardium (Trigoniocardia) spiekeri* Olsson, 1932, Bulls. Amer. Paleontology, vol. 19, p. 100, pl. 8, figs. 3, 7.

Several specimens from Puerto Jama appear to belong to this species rather than to *T. obovale* Sowerby. *Trigoniocardia spiekeri* is common in



the Upper Miocene of northern Peru, from which it was first described by Nelson as *Hemicardia affinis*. It is very close to *obovale* Sowerby, differing only by its more flattened ribs and narrower interspaces.

*Occurrence*.—Jama formation, Puerto Jama. A.N.S.P. 13712.

***Cardium* (*Trigoniocardia*) *obovale* Sowerby**

A common recent species.

*Occurrence*.—Canoa formation, Punta Blanca.

***Cardium* (*Trigoniocardia*) *graniferum* Broderip & Sowerby**

A recent species but everywhere less common than *C. obovale*.

*Occurrence*.—Canoa formation, Punta Blanca.

***Cardium* (*Mexicardia*) *procerum* Sowerby**

A recent species widely distributed in the Panamic fauna.

*Occurrence*.—Jama formation, Puerto Jama. Canoa formation, Punta Blanca.

***Laevicardium elenense* Sowerby**

*Occurrence*.—Canoa formation, Punta Blanca.

***Laevicardium pedernalense* new species**

Plate 14, fig. 2.

Shell subcircular, slightly oblique, fragile; umbones prominent, the small beak situated at the anterior third; anterior end and ventral side evenly rounded, the posterior end straighter; surface smooth but with about 36 faintly visible ribs, somewhat more distinct anteriorly. Hinge of right valve with two hook-shaped cardinal teeth and strong laterals; inner margins of valve weakly crenulated by the internal ribbed structure except along the posterior side and for a shorter space on the anterior.

Height 31.5 mm., diameter 32 mm., semidiameter 11.5 mm. Type.

Only a single specimen was obtained. It is a larger and more circular species than *L. elenense* Sowerby.

*Occurrence*.—Jama formation, Puerto Jama. Type A.N.S.P. 13657.

## VENERIDAE

***Dosinia* (*Dosinidia*) *grandis* Nelson**

*Dosinia grandis* Nelson, 1870, Trans. Conn. Acad. Sci., vol. 2, p. 201.

*Dosinia* (*Dosinidia*) *grandis* Spieker, 1922, Johns Hopkins University, Studies in Geology, no. 3, p. 138, pl. 8, fig. 4.

*Dosinia* (*Dosinidia*) *titan* Maury, 1925, Bulls. Amer. Paleontology, vol. 10, p. 139, pl. 24, figs. 1, 2; pl. 25, fig. 3.

*Dosinia* (*Dosinidia*) *grandis* Palmer, 1927, Pal. Amer., vol. 1, p. 275, pl. 17, fig. 12; pl. 19, fig. 8; pl. 20, fig. 14, pl. 45, figs. 1, 2, 3, 4.

*Dosinia* (*Dosinidia*) *grandis* Olsson, 1932, Bulls. Amer. Paleontology, vol. 19, p. 105.

This species is closely related to *Dosinia ponderosa* Gray of the recent fauna and should probably be separated only as a subspecies. It is chiefly

distinguished from *ponderosa* by its heavier shell and coarser sculpture. In northern Peru it occurs in both Upper Miocene and Pliocene beds and is also common as fossil in the Springvale beds of Trinidad. It is common at Punta Blanca, the largest specimens having the following measurements: Length 129 mm., height 116 mm., diameter 60 mm.

*Occurrence*.—Canoa formation, Punta Blanca.

***Tivela byronensis* Gray**

In the upper layers at Puerto Jama.

*Occurrence*.—Jama formation, Puerto Jama.

***Macrocallista squalida* Sowerby**

Small shells only.

*Occurrence*.—Canoa formation, Punta Blanca.

***Pitar (Lamelliconcha) affinis* Broderip**

*Occurrence*.—Canoa formation, Punta Blanca.

***Pitar (Lamelliconcha) salanga* new species**

Plate 15, figs. 10, 11.

Shell of medium size, ovate, the anterior end well rounded, the posterior produced in a rounded point; the valves are not very convex, beautifully ornamented with strong, equidistant concentric ridges which extend from the edge of the lunule across the valves to the posterior-dorsal margin; a flattened band extends from the beaks on the anterior side of the umbonal angle to the posterior ventral margin; the sculpture consists of evenly spaced concentric ridges spaced about 1 mm. apart on the center of the shell; on the anterior side alternate ridges are stronger, and on the umbonal slope the alternate ridges continue only across to the dorsal margin, elsewhere the concentric ridges are of equal strength; interior showing a plain ventral margin, a wide pallial sinus extending past the middle. Hinge normal, the right valve with 3 cardinal teeth, the upper one being double and with a socket for the lateral.

Length 37 mm., height 28 mm., semidiameter 9 mm. Type.

Length 39 mm., height 29 mm., semidiameter 10 mm.

Length 35 mm., height 26.3 mm., semidiameter 9 mm.

This species is related to *Pitar affinis* Broderip of the recent West Coast fauna, and within certain limits, both species are very variable. *Pitar salanga* is distinguished from *affinis* in being constantly higher and with a less produced or pouting posterior extremity. The sculpture in *affinis* is usually coarser, with a tendency to become irregular towards the ventral margin.

*Occurrence*.—Jama formation, Puerto Jama. Type A.N.S.P. 13692.

***Chione traftoni* new species**

Plate 16, fig. 4; plate 17, fig. 4.

Shell subelliptical in form and of medium weight; the ventral margin is semicircular, the posterior blunt, the anterior rounded, slightly produced;

the shell is beautifully sculptured with strong, doubled riblets and a series of thin, concentric, grooved lamellae which extend as continuous leaf-like frills from the edge of the lunule to the dorsal margin. On the umbones the radial riblets are strong and separated from each other by grooves of nearly the same width; later the riblets are made double by an impressed groove along the middle, while at the same time small interstitial cords appear in the interspaces, slowly increasing in strength but never equal to the primary radials in size; the concentric lamellae are ornamented in harmony with the ribbed sculpture on the upper or dorsal surface, in reverse on the ventral side; escutcheon very narrow, sometimes nearly absent in the right valve, wider, smooth and excavated in the left valve; lunule small, narrowly cordate, lamellose; interior showing a very small pallial sinus. The ventral and lunular margins of the valves are crenulated; hinge normal.

Length 52 mm., height 43 mm., semidiameter 17 mm. Type.

Length 57 mm., height 49 mm., semidiameter 18 mm.

The type of this species (A.N.S.P. 13702), comes from the Pleistocene of Quebrada Rabo de Puerco, near Puerto Armuelles, Chiriqui Province, western Panama, and is named for Mr. Mark Trafton Jr., who was the first to collect in the Pleistocene beds at this locality. The species is somewhat variable, some shells being more circular, convex, and with a sculpture of finer ribs than the form here considered as typical. The concentric lamellae are thin, typically widely spaced and appear to be unprovided with the tooth-like extensions of *Chione gnidia* and its allies. A few specimens, apparently of this species, were collected in the Pliocene at Punta Blanca, Ecuador.

*Occurrence.* — Pleistocene, Quebrada Rabo de Puerco Puerto Armuelles, Panama. Canoa formation, Punta Blanca. Type A.N.S.P. 13702. Figured specimens A.N.S.P. 13707 and 14488.

***Chione manabia* new species**

Plate 16, figs. 1, 3.

Shell of medium or large size, thick and moderately convex; the form is irregularly oval but with the posterior side more pointed than the anterior. The surface is sculptured with numerous riblets and strong, frilled, widely spaced concentric ridges; the radial riblets commence on the beaks and extend across the umbones as narrow, simple cords separated by slightly narrower interspaces; they soon become divided by a median impression, and later small cords appear in the interspaces and quickly increase in size so that on the lower part of the shell the riblets appear to be a series of subequally spaced cords. The concentric ridges begin at the edge of the lunule and extend across the surface to the edge of a zone along the umbonal slope, but later across it to the escutcheon; the ridges, where they arise from the shell, show a series of crowded rib-like bases which are lamellated along their summits and finely toothed at intervals as in *Chione gnidia*; later the buttressed bases of the concentric ridges thicken and coalesce so that they become solid and appressed in character; the umbonal slope is differentiated into a zone which is smoothish or sculptured in the young only by very weak radial lines, but in old shells is crossed by the extensions of the concentric ridges; it is bordered on the umbonal side by a narrow strip of 3

simple riblets, over which the concentric sculpture does not pass; escutcheon narrow, elliptical, smooth, flat, often separated from the umbonal slope by a small fold; lunule narrowly heart-shaped, bounded by a groove. Inner ventral margin, including that of the lunule, crenulated; pallial sinus very small (about 8 mm. deep in the type), pointed; hinge normal.

Length 94.5 mm., height 82 mm., semidiameter 27 mm. Type.

Length 90 mm., height 77 mm., semidiameter 26 mm.

Length 52 mm., height 41.5 mm., diameter 29.5 mm. Paratype.

From the group of *Chione gnidia* Broderip and Sowerby, this species is immediately distinguished by the absence of strong "teeth" on the concentric lamellae. *Chione variabilis* Nelson from the Tumbez beds of northern Peru, is equal to the present species in size, but is more elliptical in form, the greatest height of the shell being located farther back of the beak. *Chione manabia* is fairly common in the bottom layers of the Pliocene formation at Punta Blanca.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13701.

***Chione venadensis* new species**

Plate 16, figs. 5, 5a.

Shell irregularly oval and moderately convex. Sculpture on the umbones of close, even radial riblets crossed at wide intervals by narrow, concentric ridges. After a height of about 10 mm. is reached, the concentric ridges become wider and elaborately sculptured on their ventrad faces; the radial ribs become split, and they are exaggerated on the concentric ridges, but scarcely noticeable in the narrow interstices. They form close series of simple and paired buttress-like nodes over the ventrad slopes of the concentric ridges. This sculpture is not readily described but is shown in Plate 16, fig. 5a. The posterior umbonal slope usually carries 3 or more simple, smooth, radial cords which are not crossed by the concentric sculpture, this is followed by a narrow area which in the right valve is sculptured by weak radials and low concentric lamellae while in the left valve this area has only fine radials. The escutcheon is flattened, a little excavated, bordered dorsally by a small ligamental ridge; lunule cordate, smooth. Internal margin finely and evenly crenulated; pallial sinus very small.

Length 32.5 mm., height 28 mm., semidiameter 11 mm. Type.

Length 30 mm., height 26 mm., semidiameter 10.5 mm.

Length 39.5 mm., height 33.25 mm., semidiameter 12 mm.

Fragments from Punta Cabuyal, north of Cabo Pasados, indicate that this species may become 65 mm. or more in length. In these large shells the sculpture close to the margin is very close, with the concentric ribs formed of the close-set, thickened and strongly appressed buttress-like nodes.

*Occurrence*.—Jama formation, Punta Venado and Punta Cabuyal. Type A.N.S.P. 13703.

***Chione jamaniana* new species**

Plate 17, figs. 1, 2.

Shell of large or medium size, subovate, strongly convex with a more or less pointed and flexed posterior extremity; umbones prominent, the small

beaks adjacent and situated at the anterior fourth; the ornamentation of the surface consists of elevated to more or less appressed concentric ridges, sculptured on their ventral side by rib or buttress-like thickened nodes; these rib-like nodes are arranged alternately as simple or double plates, the double ones provided with a tooth-like projection or frill (when preserved) on their summit; posterior-dorsal submargins feebly differentiated only, its sculpture being made by smaller, more regular riblets crossed by the concentric lamellae which, however, end at the edge of the escutcheon between the lamellae; the surface is marked by small grooves arranged in harmony with the ribs of the lamellae or often nearly smooth with crowded growth-lines only; escutcheon excavated, smooth, its dorsal side marked by a smaller, elevated ridge on the side of the ligament; lunule large, broadly cordate, sculptured by coarse growth-lines only; pallial sinus very small, the ventral margin coarsely crenulated.

Length 76 mm., height 67 mm., diameter 54 mm. Type.

Length 41 mm., height 34 mm., diameter 26 mm.

Length 56 mm., height 48 mm., diameter 33 mm.

From *Chione gnidia* Broderip & Sowerby, in the recent fauna, to which this species is most closely related, it differs by its more solid shell and stronger sculpture. In *Chione gnidia* the concentric lamellae remain very thin with erect tooth-like processes, while in the present species the ridges are solid, appressed, and the spaces between them tend to become smooth in old shells. It is a more convex species than *Chione manabia* and *vena-densis* from which it is also separated by its excavated escutcheon.

*Occurrence*.—Jama formation, Puerto Jama. Canoa formation, Punta Blanca. Type A.N.S.P. 14487.

***Chione (Lirophora) kellesti* (Hinds)**

Plate 16, fig. 2.

*Venus kellestii* Hinds, 1844, Zool. Voy. Sulphur, Moll., p. 65, pl. 19, figs. 5.

We have but a single, left valve of this interesting species. It was described by Hinds from the Island of Quibio, off the coast of the Province of Veragua, Panama. Our shell is of medium size, solid and moderately convex. The sculpture consists of a series of low, more or less radially wrinkled or striated concentric folds which cover the beak and a part of the umbonal region, becoming merely wide, smooth, low bands on the central and remaining portions of the shell. On the posterior-dorsal slope there is a radial, foliated band of thin, elevated, lamellar ribs which extend from the beak clear to the posterior extremity, while a smaller but similar foliated band borders the lunular side. Our specimen measures as follows: Length 40.5 mm., height 32 mm., semidiameter 11 mm.

*Occurrence*.—Canoa formation, Punta Blanca. Figured specimen A. N. S. P. 14483.

***Chione (Lirophora) mariae* d'Orbigny**

Common as a fossil at Punta Blanca and as a recent species along the coast of Ecuador. The shell is always small, seldom exceeding 25 mm. in

length, the average less than 20 mm. The spacing and strength of the concentric ribs are variable.

*Occurrence*.—Canoa formation, Punta Blanca.

*Chione (Lirophora) gorgona* new species

Plate 19, fig. 2.

Shell solid and strongly sculptured; somewhat subtrigonal, height about three-fourths of the length. The posterior end is produced and bluntly pointed, the anterior end a little more evenly rounded, between them the ventral margin is broadly and smoothly rounded. The sculpture is of strong, thick, concentric ribs which commence at the edge of the lunule and extend across to the escutcheon but become thin and pinched out along a narrow zone at the posterior end. On the umbones, or in young shells, the concentric ribs are thin, erect but recurved, elsewhere they are thick, rounded folds, their free edges slightly recurved or overturned, between deep, smooth interspaces; the ribs vary in number; when relatively few they are thicker in section, thinner when more numerous; the thin or lamellated posterior zone along the edge of the escutcheon is quite narrow; the ribs also sometimes tend to become lamellose just below the lunule, on old shells. Posterior-dorsal margin straight, the anterior-dorsal concave. Valve cavity rather deep; the pallial sinus is very small, and the ventral margin is finely crenulated; lunule smooth, heart-shaped, defined by an impressed line; escutcheon wide, excavated, smooth, marked off from the rest of the shell by the ending of the ribbed sculpture and by an angular ridge.

Length 37 mm., height 28 mm., semidiameter 10 mm. Type.

Length 34.5 mm., height 26.5 mm., semidiameter 9.5 mm.

Perhaps this shell should be considered a subspecies of *Chione mariae* d'Orbigny, which it resembles in form and sculpture. *Chione mariae*, as it occurs in the Pliocene of Punta Blanca and in the recent fauna, is a small form seldom exceeding 21 mm. in length, while *Chione gorgona* is nearly twice that size. *Chione gorgona* differs from *Chione paphia* L. by its longer shape and by the narrower, foliated area along the posterior ridge. It may be noted here that there is a recent specimen of a *Lirophora* from Cartagena, Colombia, in the Olsson Collection, which is very similar to *gorgona* except in being a little more convex.

*Occurrence*.—Jama formation, Puerto Jama.

*Anomalocardia callistoides* new species

Plate 14, figs. 4, 5, 8.

Shell solid, elliptical-oblong, widest in the anterior portion or along a line extending from the beak obliquely to the anterior-ventral margin, which is also the zone of greatest inflation; posterior extremity narrowly rounded; the ventral margin is but slightly convex in the posterior portion, becoming broadly rounded in the anterior portion; lunule elliptical, depressed or flattened, smooth, defined by an incised line; escutcheon narrow, excavated, a little wider in the left valve and its boundary more strongly angular. The shell is solid, its surface smooth, slightly polished except on the anterior portion which has a series of strong, regular, wave-like concentric ribs;

these ribs cover the small umbones but elsewhere extend over only the anterior third of the surface, running to the edge of the lunule; some shells show faintly 2 brownish rays extending from the beak across the middle part of the shell. Cavity of valves of moderate depth, the adductor scars usually well-impressed but not deeply so, the pallial sinus short, extending scarcely beyond the line of the posterior adductor; hinge normal, with strong cardinal teeth; ventral margin smooth.

Length 43 mm., height 29.3 mm., semidiameter 10.5 mm. Type.

Length 40.5 mm., height 28.5 mm., semidiameter 10 mm. Paratype.

Length 41.2 mm., height 27.5 mm., semidiameter 10.5 mm. Paratype.

This species is very common in the upper zone of the Jama formation at Puerto Jama, but was found at no other locality. It differs strikingly from other *Anomalocardias* of the West Coast by its lengthened form. The concentric ribs cover only a small area on the extreme umbones, and often are worn away there, and on the rest of the shell only across the anterior third; elsewhere the surface is smooth and porcellaneous.

*Occurrence*.—Jama formation. Upper Zone at Puerto Jama. Type A.N.S.P. 13658.

***Cyclinella galera* new species**

Plate 12, fig. 1; plate 19, fig. 4.

Shell subcircular, moderately convex; the beaks are small, situated in front of the anterior fourth, pointed forward; dorsal, posterior and ventral margins rounded; surface covered with fine concentric growth-lines, somewhat sharp near the ventral margin; interior of left valve with a deep, pointed pallial sinus reaching nearly to the center of the valve.

Height 57.5 mm., length 55 mm., semidiameter 17.7 mm. Type.

We have but one specimen of this species, and that is imperfect. It is distinguished by its nearly circular outlines, the anterior side being not depressed or extended as usual amongst most species of this genus. From *C. singleyi* Dall, which it resembles in form, it differs by the shape and direction of the pallial sinus.

*Occurrence*.—Jama formation, Puerto Jame. Type A.N.S.P. 13698.

***Cyclinella subquadrata* Hanley**

*Occurrence*.—Canoa formation, Punta Blanca.

***Clementia* (Egesta) *solida* Dall**

This is probably the first time that this recent species has been found fossil. From the common *Clementia dariena* Conrad of the Caribbean and West Coast Miocene it differs by its form, much heavier shell, in having the concentric undulation more narrowly restricted to the umbones, and by the characters of the pallial sinus. *Clementia solida*, originally described from Gulf of Panama, is now known to range as far south as Ecuador, on the basis of 2 shells collected on the beach at Pedernales.

*Occurrence*.—Jama formation, Puerto Jama.

## TELLINIDAE

*Tellina* (*Eurytellina*) *prora* Hanley

A single, broken specimen, probably this species.

*Occurrence*.—Jama formation, Puerto Jama.

*Tellina* (*Eurytellina*) *ecuadoriana* new species

Plate 15, figs. 6-8.

Outlines of shell as figured, the beaks are nearly central and the valves a little convex and slightly flexed posteriorly. The posterior-dorsal margin is nearly straight, sloping to the narrowly truncate posterior extremity, anterior end rounded. Sculpture consists of flat, concentric ridges which are developed over most of the shell, except on the posterior slope which is smooth. At the posterior end a wide, flattened ray extends from the beak to the posterior extremity. It is smooth, marked only by lines of growth. Interior of right valve has 2 cardinal teeth, the posterior one large and bifid, and 2 laterals, the anterior one adjacent to the cardinals. Left valve has a single bifid cardinal and 2 small laterals. The ample pallial sinus is confluent below with the pallial line. Dorsal margins of the left valve not expanded or specially sculptured.

Length 58 mm., height 31 mm., semidiameter 4.5 mm. Punta Blanca.

Length 49 mm., height 28 mm., semidiameter 4 mm. Type.

The shell is longer than *T. princeps* Hanley which is similar in outline, but that species is distinguished by its minute radial sculpture. It is more nearly related to *T. rubescens* Hanley, a higher shell, and especially to *T. simulans* C. B. Adams, which differs chiefly by the smaller angle formed by the dorsal margins and the slightly greater height. These 3 species form a very closely related group, but they seem to be distinguishable. We have but a single fossil specimen but it is a fairly common species along the coast of Ecuador. The recent shell is deep rose-colored with ill-defined whitish or white zones.

*Occurrence*.—Canoa formation, Punta Blanca (fig. 6). Recent from S. Elena (fig. 8, Type, A.N.S.P. 175551), Canoa (fig. 7), and Callo, the port of Jipijapa.

*Tellina* (*Eurytellina*) *laplata* new species

Plate 15, figs. 1-5.

Shell with outlines as figured, the anterior side a little longer than the posterior and the valves a little convex. The dorsal slopes are nearly straight, the posterior sloping more rapidly to the extremity which is narrowly truncated, while the anterior extremity is rounded. Sculpture of flat, concentric ridges separated by linear grooves, in some specimens strongly developed over the whole surface, while in others the sculpture tends to become subobsolete on the ventral portion. In the left valve the anterior-dorsal margin is widely expanded and sculptured by a series of strong, waved ridges which are the continuations of alternate ones of the concentric ridges of the surface sculpture (fig. 4). The posterior-dorsal margin is similarly expanded and sculptured. In the right valve the anterior-dorsal margin is excavated. Both valves have a flexed, posterior concave fold or ray extending from the beak to the posterior extremity, sculptured by cross ridges,



the continuation of alternate ridges of the surface sculpture. Interior with a single, bifid cardinal tooth in the left valve, along with 2 lateral, the anterior one being very small. The right valve has 2 cardinal teeth, the posterior one bifid, and 2 laterals. Pallial sinus ample, confluent with the pallial line below.

Length 47 mm., height 29 mm., semidiameter 7.5 mm. Type, left valve.

Length 40.4 mm., height 25 mm., semidiameter 4.5 mm. Right valve.

Length 38.2 mm., height 23.5 mm., semidiameter 4.5 mm. Left valve.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13693.

***Tellina (Eurytellina) panamanensis* Li**

For a figure of this recent species see Pilsbry, 1931, *The Miocene and Recent Mollusca of Panama Bay*, Proc. Acad. Nat. Sci. Phila., vol. 83, p. 436, pl. 41, figs. 4, 5, 6.

*Occurrence*.—Jama formation, Puerto Jama. Canoa formation, Punta Blanca.

***Tellina (Macaliopsis) aequizonata* new species**

Plate 14, fig. 7.

Shell thin and fragile, oval, longer than high, the valve only very slightly convex. The dorsal margin behind the small beak is slightly convex, while in front the dorsal margin is at first concave, then straight, finally becoming broadly convex as it passes into the anterior extremity. The basal margin is broadly rounded. The sculpture is formed of a series of widely spaced, elevated very narrow concentric ridges, becoming more closely spaced and somewhat irregular ventrally. The interspaces are smooth or marked only faintly by growth lines. There is a narrow posterior-dorsal area which is depressed and across which the concentric ridges do not normally pass.

Length 55 mm., height 42 mm., semidiameter 4.5 mm. Type.

In external appearance this species resembles a *Phacoides*. It is much larger, more strongly sculptured and more circular in outlines than the *T. lyra* Hanley of the recent Panama fauna.

*Occurrence*.—Jama formation, Puerto Jama. Type A.N.S.P. 13660.

***Tellina (Macaliopsis) lyrica* Pilsbry & Lowe**

Plate 14, fig. 6.

This species is represented by a single, imperfect specimen. It differs from *T. lyra* Hanley, of the present Panama fauna, in being longer and more finely sculptured. It was described from Guaymas, on the west coast of Mexico.

*Occurrence*.—Canoa formation, Punta Blanca.

***Tellina (Merisca) crystallina* Wood**

Several specimens. Although generally reported rare, as a recent species, it is widely distributed and sometimes fairly common in some localities. At present it is found living along both the Caribbean and Pacific coast of Central America and as fossil extends back into Miocene time.

*Occurrence*.—Canoa formation, Punta Blanca.

**Tellina (*Angulus*) cf. *felix* Hanley**

We have several specimens of an *Angulus* which is probably this species described by Hanley from Panama. Our shells are identical with the species occurring in the Tumbes beds of northern Peru.

*Occurrence*.—Canoa formation, Punta Blanca.

**Tellina (*Quadrans*) *cognata* C. B. Adams**

In the upper layers at Puerto Jama.

**Macoma *plebeia* Hanley**

*Occurrence*.—Jama formation, Puerto Jama.

**Macoma *grandis* Hanley**

*Occurrence*.—Canoa formation, Punta Blanca.

**Macoma *lamproleuca* Pilsbry & Lowe**

This species was based on a single valve collected by Lowe at Corinto, Nicaragua. It is quite common along the north Peruvian and Ecuadorian coast and has been collected at the following localities: Zorritos and Tumbes, Peru; Punta Blanca, Manta, and Atacamas, Ecuador; Panama, Bucaru, and San Carlos, Panama.

*Occurrence*.—Jama formation, Puerto Jama. Canoa formation, Punta Blanca.

By error this species was referred to as *Macoma parthenopa* in Proc. Acad. Nat. Sci. Phila., vol. 84, p. 144, 1932.

**Macoma (*Cymatoica*) species undetermined**

Plate 15, fig. 9.

Small fragments, that figured 7.6 mm. long, noticed here merely to show the occurrence of this group.

**Subgenus MACOPLOMA new subgenus**

Shell elongate, nearly equivalve, the left valve a little larger and more convex than the right; surface with the granulation of *Periploma*, developed most strongly on the posterior area, finer or absent from the rest of the surface; hinge of *Macoma*, with a small cardinal tooth in the left valve and no laterals. Type *Macoma ecuadoriana* new species.

Distinguished from the other members of the genus *Macoma* by the granulation of the posterior submargins, strongly suggestive of that of *Periploma*. Another unnamed species is common in some Pliocene beds of western Panama, and consequently we feel that the group has a certain systematic value and should be recognized by name.

**Macoma (*Macoploma*) *ecuadoriana* new species**

Plate 19, fig. 5.

Shell elongate, the valves subequal but with the left a little larger and more convex than the right, which is somewhat depressed or flexed across

the middle; beaks situated a little in front of the posterior third, small, pointed and adjacent; anterior side long, the posterior short, truncated at its end; surface marked with lines of growth and a scattered granulation, best developed on the posterior submargins, fine or absent elsewhere; the hinge of the left valve has a small, partly double cardinal tooth but no laterals.

Length 61 mm., height 33 mm., diameter 16.5 mm. Type.

This shell resembles *Macoma lamproleuca* Pilsbry & Lowe, but is distinguished by the coarse granulation of its posterior area. Although quite common in some layers, a perfect shell is seldom obtained, and the hinge has been observed in only a few specimens.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13699.

***Apolymetis excavatus* Sowerby**

Poor specimens only.

*Occurrence*.—Jama formation, Puerto Jama.

**SEMELIDAE**

***Semele laevis* Sowerby**

Some of the fossils are large, heavy shells measuring as follows: Length 100 mm., height 80 mm., semidiameter 17 mm.

*Occurrence*.—Jama formation, Puerto Jama.

***Semele jaramija* new species**

Plate 17, fig. 5.

Shell small, suboval in form, with the beaks placed a little in back of the middle; but little convex; the sculpture consists of strong, regular, concentric threads, well developed over the whole shell and at the anterior-upper end, these concentric threads are cut by a series of small radial grooves; at the posterior end the grooves, about 8 in number, are crossed by the concentric threads, the sculpture being beautifully cancellated.

Length 21 mm., height 16 mm., semidiameter 3.5 mm. Type.

We have but a single right valve of this beautiful small shell.

*Occurrence*.—Canoa formation, Punta Blanca. Type A.N.S.P. 13709.

**PSAMMOBIIDAE**

***Tagelus (Mesopleura) peruvianus* new species**

Plate 18, fig. 5.

The shell is broad, elongate, its height about a third of its length, parallel sided, and of moderate convexity; the small beak is located not quite centrally, the posterior end being the longer; ventral margin straight, the dorsal a little arched on the anterior side, winged on the posterior; ends rounded, the posterior obliquely so; surface marked by growth-lines which are strongest on the anterior and posterior ends; the shells are usually a little warped in the middle, producing a small gap at each end; when young, the interior shows the well-marked thickened ray of *Mesopleura*, but in the adult this rib may disappear entirely or persists only in a slight thickening of this part of the shell; pallial sinus ample, rounded, higher within the shell than at its opening, reaching not quite to the middle of the length.

When young the shell is quite thin, translucent, tinged with lilac, the rays brownish; epidermis dark olive-black usually absent from the umbones, which are light-colored and rayed.

Length 85 mm., height 28.5 mm., semidiameter 8 mm. Type.

The above description is based partly on fossil but the last sentence on recent shells. It differs from *Tagelus* (*Mesopleura*) *dombeii* Lamarck of the same coast, by its proportionately higher shell and specially by the peculiar flange or wing-like posterior-dorsal margin. *Tagelus peruvianus* is very common at Punta Blanca, being the dominant species in Zone I.

*Occurrence*.—Punta Blanca beds. Type A.N.S.P. 13707. Recent, coast of Northwest Peru and Ecuador.

***Solecurtus broggii* new species**

Plate 18, fig. 4.

Shell rather large, broadly Soleniform, moderately convex, with a wide, open, posterior gap; dorsal and ventral margins parallel, nearly straight, the anterior end rounded, the posterior flatly rounded to subtruncate; umbones not prominent, with the small beak a short distance behind the front third of the length. Surface marked with lines of growth except on the posterior area where, in addition, there is a series of spaced, irregular lines which cross the shell vertically and bend obliquely forward near their lower ends. There are also faint, wide, depressed rays radiating from the umbones to the ventral margin, from the vertical of the beaks backward. Interior of right valve with a deep, wide, pallial sinus reaching to a point forward of the line of the beaks; anterior adductor scar fairly distinct, situated well into the interior of the valve in its dorsal portion. Hinge with a large, erect, hook-shaped cardinal tooth, preceding a small, oblique pit of the resilium and a large, thick, erect plate for the attachment of the ligament. (In life the shell is covered with a black epidermis).

Length 84 mm., height 33 mm., semidiameter 10.3 mm. Type.

In the recent fauna *Solecurtus broggii* appears to be restricted to the coast of Ecuador and northern Peru or to the southern part of the Panama faunal province. It is fairly common as fossil at Jama but usually only in a fragmentary condition. Some of these fragments indicate a shell much larger than any recent specimens known.

On *Solen strigilatus* as type of *Solecurtus*, see R. B. Stewart, 1930, Acad. Nat. Sci. Phila., Special Pub. no. 3, p. 293. *Solecurtus galapaganus* Dall (as *Psammosolen*) is figured by Dall & Ochsner (Proc. Calif. Acad. Science, Ser. 4, vol. 17, pl. 3, fig. 10, pl. 4, fig. 8) from the Pleistocene of Albermarle Island. This species occurs also in the Pleistocene of the Burica Peninsula in western Panama. It is a smaller, thinner shell than *broggii*, the posterior side more rounded at the end and with a different surface sculpturing, the oblique ridges being generally weaker and covering principally the central part of the valves.

This species is named for Dr. J. A. Broggi, Secretario de la Sociedad Geologica del Peru.

*Occurrence*.—Jama formation, Puerto Jama. Also recent, the Type, A.N.S.P. 175547, from Callo, Port of Jipijapa, Ecuador.

### PANOPEIDAE

*Panopea* cf. *coquimbensis* d'Orbigny

Plate 18, fig. 1.

cf. *Panopaea coquimbensis* d'Orbigny, 1842, Voy. dans l' Amér. merid., Paleontologie, vol. 3, pt. 4, p. 126, pl. 15, figs. 7, 8.

cf. *Panopaea coquimbensis* Philippi, 1887, Die Tert. und Quart. Versteinerungen Chiles, p. 166, pl. 34, fig. 1.

cf. *Panopaea coquimbensis* Mörch u. Steinmann, 1896, Die Tertiärbildungen des nördlichen Chile und ihre Fauna. Neues Jahrb. f. Min. etc. Beil. Bd., vol. 10, p. 586.

*Panopea* cf. *coquimbensis* Olsson, 1932, Bulls. Amer. Paleontology, vol. 19, pp. 145, 146, pl. 13, fig. 6.

A species of *Panopea* is not uncommon in the Pliocene of Punta Blanca, but we have been unable to obtain a perfect specimen. It differs from *P. similis* Dall & Ochsner<sup>11</sup> from the Pliocene of Indefatigable Island of the Galapagos group, by its higher shell, in being more strongly inflated in front and less produced posteriorly. The shell is fairly thin, with a sculpture of strong, concentric undulations covering the umbones, gradually fading away ventrally, where there are fine, distinct striae of growth. The same species is known to occur in the Upper Miocene or Tumbes beds of northern Peru, where it has been listed as *P. cf. coquimbensis* d'Orbigny. Smaller specimens of a very similar *Panopea* are found in the Cardalitos shales. The only figure of the Chilian shell known to us is that of a cast of the interior, so that the above identification must be considered as tentative.

Measurements of our largest shell are as follows: Length 158 mm., height 101 mm., diameter 62 mm. The broken specimen in fig. 1 is 90 mm. long.

*Occurrence*.—Canoa formation, Punta Blanca.

*Sanguinolaria tellinoides* C. B. Adams

*Occurrence*.—Jama formation, Puerto Jama.

### DONACIDAE

*Donax dentiferus* Hanley

*Occurrence*.—Jama formation, Puerto Jama.

*Donax punaensis* new species

Plate 12, fig. 2.

Shell small, transversely elongate, rather thin, smooth; beaks small, pointed, a little behind the anterior third of the length. Anterior dorsal margin nearly straight, sloping, the posterior dorsal margin straight. Posterior end rather narrowly rounded; and somewhat obliquely rounded. Ventral margin straight in front, weakly convex back of the middle. Ventral margin evenly crenulated within.

<sup>11</sup> Dall and Ochsner, 1928, Tertiary and Pleistocene Mollusca from the Galapagos Islands. Proc. Calif. Acad. Sci., ser. 4, vol. 17, p. 125, pl. 5, fig. 1.

Length 25 mm., height 9.7 mm., semidiameter 2.8 mm. Type.

*Donax punaensis* is similar to *Donax gracilis* Hanley but is larger, of different form, and the anterior side is longer and wider, but it is not so wide as in *D. petallinus* Desh.

It is fairly common in the Puna Island Pliocene, but like most of the other fossils, it is generally broken.

*Occurrence*.—Pliocene of the north end of Puna Island. Type A.N.S.P. 13713.

### MACTRIDAE

*Mactra* (*Mactrella*) *alata* Spengler

This species is now known to be living along both the Pacific and Caribbean coast of Central and northern South America (see Nautilus, vol. 48, p. 105).

*Occurrence*.—Jama formation, Puerto Jama. Canoa formation, Punta Blanca.

*Mactra* (*Micromactra*) *atacama* new species

Plate 14, figs. 1, 3.

The shell is white, transversely elongated, compressed, gaping slightly posteriorly. The anterior end is obliquely rounded and somewhat shorter than the posterior which is bluntly pointed; the anterior-dorsal margin straight, the posterior-dorsal very slightly convex. The surface is smooth, with very fine, irregular growth-lines, and a series of small, wave-like undulations near the beaks, stronger at the sides. Posterior-dorsal area narrow, defined by an angular ridge; its surface with rougher lines of growth and a faint ray between the middle and the umbonal ridge; pallial sinus wide, rounded at the end, reaching to or very near the middle of the valve.

Length 60.5 mm., height 37 mm., semidiameter 9.4 mm. Type.

The type is a right valve collected at Atacames, Province of Esmeraldas, and we have other recent specimens from many other localities along the Ecuadorian coast. From other *Micromactras* of the Panama faunal province this species is distinguished by its generally larger size. *M. angusta* Desh. has a much longer pallial sinus, and is not quite so high. *M. isthmica* is higher, with stronger shell and hinge, and is covered with a dark periostracum. The fossils from Punta Blanca and Jama are exactly similar to recent shells except that the specimens from Jama are sometimes much larger than any recent examples in our collection.

*Occurrence*.—Jama formation, Puerto Jama. Punta Blanca beds. Also recent, the type 175548 A.N.S.P. from Atacames.

*Mulinia pallida* Broderip & Sowerby

*Occurrence*.—Jama formation, Puerto Jama, Punta Cabuyal.

**Mulinia camina** new species

Plate 19, figs. 6, 7.

Shell trigonal-suboval and moderately plump; umbones a little before the middle, the small beaks not touching, separated from the margins by a narrow smooth zone. The anterior end is narrowly rounded, the posterior obliquely subtruncate; lunule large, extending almost the entire length of the anterior dorsal margins and weakly defined by a very faint line. Posterior-umbonal angle well marked, forming a moderately wide and somewhat convex posterior-dorsal area; surface smooth, polished, except for the growth-lines; hinge not seen.

Length 27.5 mm., height 20.5 mm., diameter 14 mm. Type.

Length 30 mm., height 23.5 mm., diameter 15.5 mm.

Length 28 mm., height 22.3 mm., diameter 14.3 mm.

Common at Punta Cabuyal, a few miles north of Cabo Pasados. It is longer than small shells of *M. pallida*, and the beaks are not so elevated. *M. zorritensis* Nelson, from the Tumbes beds of northern Peru, is a smaller species with more pointed beaks.

*Occurrence*.—Jama formation, Punta Cabuyal. Type A.N.S.P. 13700.

**Mulinia guayasensis** new species

Plate 19, figs. 3, 8.

Shell elongate-suboval, thin, moderately convex; umbones wide but not prominent, with the small beaks separated from the margin by a narrow zone; posterior side longer than the anterior, produced, bluntly pointed at the end, with a low angle extending to the beak and bordering a flattened posterior-dorsal area; anterior end rounded, somewhat depressed; surface marked with irregular lines of growth; hinge with an inverted V-shaped cardinal tooth bordered posteriorly by a smaller lamella and the deep chondrophore, lateral teeth on each side elongate; pallial sinus not evident.

Length 50 mm., height 33.5 mm., semidiameter 9.5 mm. Type.

The only specimen in our collection is a broken left valve, which by its elongate form and strongly produced posterior extremity is very different from any recent *Mulinia* from the West Coast of tropical America.

*Occurrence*.—Puna Island. Type A.N.S.P. 13697.

**Labiosa (Raeta) undulata** (Gould)

*Lutraria undulata* Gould, 1851, Proc. Boston Soc. Nat. Hist., vol. 4, p. 89; Journ., vol. 6, pl. 15, fig. 7.

*Labiosa (Raeta) undulata undulata* Olsson, 1932, Bulls. Amer. Paleontology vol. 19, p. 131, pl. 14, fig. 11.

*Anatina (Raeta) undulata* Grant & Gale, 1931, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 407, pl. 23, figs. 5a, 5b, 5c.

*Labiosa undulata* is quite common at Puerto Jama, but because of its thin, delicate shell it is usually crushed or distorted. A large, well-preserved specimen measures as follows: Length 80 mm., height 62 mm. diameter 44 mm. As a recent species it is widely distributed along the coast of northern Peru and Ecuador, northward through Panama to Lower California. It appears to be more common in the southern part of its range.

*Occurrence*.—Jama formation, Puerto Jama.

***Harvella elegans* *tucilla* Olsson**

*Harvella elegans tucilla* Olsson, 1932, *Bulls. Amer. Paleontology*, vol. 19, pp. 129, 130, pl. 14, fig. 1.

Differs from typical *H. elegans* by its much larger size and stronger sculpture, the concentric ribs being spaced evenly over the whole shell. A specimen from Puerto Jama measures as follows: Length 95 mm., height 82 mm., semidiameter 25 mm. The largest specimen of recent *elegans* which we have seen measured about 75 mm. long, but the average size is much smaller, about 55 mm.

*Occurrence*.—Jama formation, Puerto Jama.

**CORBULIDAE*****Corbula ecuabula* new species**

Plate 12, figs. 3, 4, 5.

Shell of medium size, moderately thin and strongly inequilateral, sub-equivalve; the right valve is quite convex with the beaks and umbones situated at the posterior third, the anterior side is therefore much longer than the posterior, strongly inflated or convex in the region of the anterior umbonal slope and rounded at its end, while the posterior end is short, its dorsal side straight, sloping, joining with the ventral margin at an obtuse angle; the posterior-dorsal area or rostrum is narrow, bounded by a weak keel or angle only; the left valve is smaller than the right with a depressed zone in the ventral region; surface smooth or marked with coarse, even growth-lines, strongest on the anterior side and on the area of the rostrum; hinge of the right valve provided with a large tooth, fitting in a socket in the left valve beside a wide, spoon-shaped cardinal.

Length 16.25 mm., height 12 mm., semidiameter 3.75 mm. Type A. N. S. P. 14486, a right valve.

Length 11.25 mm., height 7 mm., semidiameter 2 mm. Left valve.

An unusual species, with the beaks situated towards the posterior side so that the shell is strongly inequilateral. A few recent specimens were collected at Punta Callo, Ecuador.

*Occurrence*.—Canoa formation, Punta Blanca.

***Corbula ovulata* Sowerby**

*Occurrence*.—Jama formation, Puerto Jama.

***Corbula biradiata* Sowerby**

*Occurrence*.—Canoa formation, Punta Blanca.

***Corbula nasuta* Sowerby**

*Occurrence*.—Canoa formation, Punta Blanca.



## EXPLANATION OF PLATES 1 TO 19

## PLATE 1.

- FIG. 1.—*Terebra* (*Terebra*) *elena* new species. Type, length 120 mm.  
 FIG. 2.—*Terebra* (*Strioterebrum*) *nelsoni* Hanna & Israelsky. Length 61 mm.  
 FIG. 3.—*Terebra nelsoni* Hanna & Israelsky. Lectotype of *T. tuberosa* Spieker, Tumbes formation, Zorritos, Peru.  
 FIG. 4.—*Terebra* (*Strioterebrum*) *blanca* new species. Type, length 56 mm.  
 FIG. 5.—*Terebra* (*Strioterebrum*) *blanca* new species. Length 44 mm.  
 FIG. 6.—*Terebra* (*Strioterebrum*) *tumaca* new species. Type, length 21 mm.  
 FIG. 7.—*Terebra* (*Strioterebrum*) *armillata sheppardi* new subspecies. Type, length 45 mm.  
 FIG. 8.—*Terebra* (*Strioterebrum*) *manta* new species. Type, length 9.5 mm.  
 FIG. 9.—*Terebra* (*Terebra*) *elena* new species. Length 96 mm.  
 FIG. 10.—*Terebra* (*Strioterebrum*) *loja* new species. Type, length 37 mm.  
 FIG. 11.—*Terebra* (*Strioterebrum*) *cuenca* new species. Type, length 41 mm.

## PLATE 2.

- FIG. 1.—*Clathrodrillia resina* Dall. Length, as broken, 31 mm.  
 FIG. 2.—*Crassispira guayana* new species. Type, length 17.5 mm.  
 FIG. 3.—*Epitonium* (*Ferminoscala*) *manabianum* new species. Type, length 37.7 mm.  
 FIG. 4.—*Mitra* (*Tiara*) *gigantea polystira* new subspecies. Type, length 66 mm.  
 FIG. 5.—*Clathrodrillia noventa* new species. Type, length 60 mm.  
 FIG. 6.—*Amphissa meridionalis* new species. Type, length 21.5 mm.  
 FIG. 7.—*Epitonium* (*Ferminoscala*) *eleutherium* new species. Type, length 21.3 mm.  
 FIG. 8.—*Clathrodrillia woodringi* new species. Type, length 19 mm.  
 FIG. 9.—*Epitonium* (*Spiniscala*) *loriphanum* new species. Type, length 13.7 mm.

## PLATE 3.

- FIGS. 1, 2.—*Cancellaria* (*Euclia*) *harpiformis* new species. Type, length 43 mm.  
 FIG. 3.—*Cancellaria* (*Tribia*) *bahia* new species. Type, length 14 mm.  
 FIG. 4.—*Cancellaria* (*Euclia*) *pacifica* new species. Type, length 40 mm.  
 FIG. 5.—*Cancellaria* (*Cancellaria*) *dolioides* new species. Type, length 17.7 mm.  
 FIG. 6.—*Cancellaria* (*Narona*) *pajana* new species. Type, length 14 mm.  
 FIG. 7.—*Cancellaria* (*Cancellaria*) *cominella* new species. Type, length 16.4 mm.  
 FIG. 8.—*Trigonostoma ecuadoriana* new species. Paratype, length 32 mm.  
 FIG. 9.—*Trigonostoma ecuadoriana* new species. Type, length 40 mm.

## PLATE 4.

- FIG. 1.—*Cancellaria* (*Cancellaria*) *jipijapana* new species. Type, length 37.5 mm.  
 FIG. 2.—*Nassa* (*Perunassa*) *ecuadoriana* new species. Type, length 36.3 mm.  
 FIG. 3.—*Cancellaria* (*Cancellaria*) *yolandia* new species. Type, length 30.7 mm.  
 FIG. 4.—*Cancellaria* (*Cancellaria*) *jipijapana* new species. Paratype, length 34.5 mm.  
 FIG. 5.—*Cymatophos galerus* new species. Paratype, length 44 mm.  
 FIG. 6.—*Strombinophos loriphanus* new species. Paratype, length 25 mm.  
 FIG. 7.—*Cymatophos galerus* new species. Type, length 38 mm.  
 FIG. 8.—*Nassa* (*Perunassa*) *ecuadoriana* new species. Paratype, length 35.5 mm.  
 FIG. 9.—*Strombinophos loriphanus* new species. Type, length 32 mm.  
 FIGS. 10, 12.—*Hanetia ecuadorensis* new species. Type, length 43.5 mm.  
 FIG. 11.—*Nassa* (*Perunassa*) *ecuadoriana* new species. Paratype, length 34 mm.

## PLATE 5.

- FIG. 1.—*Hanetia cymioides* new species. Type, length 50 mm.  
FIG. 2.—*Trigonostoma ecuadoriana* new species. Paratype, length 36 mm.  
FIG. 3.—*Hanetia boggsi* new species. Paratype, length 43.3 mm.  
FIG. 4.—*Hanetia boggsi* new species. Type, length 43.8 mm.  
FIG. 5.—*Nassa puntablancana* new species. Type, length 25 mm.  
FIG. 6.—*Bursa nana* Sowerby. Length 42.5 mm.  
FIG. 7.—*Strombina ecuadoriana* new species. Paratype, length 20 mm.  
FIG. 8.—*Strombina ecuadoriana* new species. Type, length 21 mm.  
FIG. 9.—*Distorsio decussatus* (Valenciennes). Length 50 mm.  
FIG. 10.—*Hindsia wheeleri* new species. Type, length 17 mm.  
FIG. 11.—*Nassa* (*Arcularia*) *puntablancana* new species. Paratype, length 25 mm.  
FIG. 12.—*Distorsio constrictus* Broderip. Length 43 mm.

## PLATE 6.

- FIG. 1.—*Nassa cara* new species. Type, length 6.8 mm.  
FIG. 2.—*Nassa cara* new species. Paratype, length 6.2 mm.  
FIG. 3.—*Tritiaria* (?) *ecuadoriana* new species. Type, length 16 mm.  
FIG. 4.—*Nassa palla* new species. Paratype, length 4.6 mm.  
FIG. 5.—*Nassa palla* new species. Type, length 5.0 mm.  
FIG. 6.—*Nassa tinosa* new species. Type, length 13.5 mm.  
FIG. 7.—*Nassa tinosa* new species. Paratype, length 13.2 mm.  
FIG. 8.—*Cantharus elegans avus* new subspecies. Type, length 55.3 mm.  
FIG. 9.—*Cantharus elegans avus* new subspecies. Paratype, length 47.5 mm.

## PLATE 7.

- FIG. 1.—*Cymatium wiegmanni* Anton. Length 75.4 mm. (imperfect).  
FIG. 2.—*Crucibulum* (*Disputaea*) *inermis* Nelson. Greater diameter 32.8 mm.  
FIGS. 3, 6.—*Semicassis centiquadrata* var. Length 43 mm.  
FIG. 4.—*Cypraea cayapa* new species. Type, length 62 mm.  
FIG. 5.—*Crucibulum alloglyptum* new species. Type, greater diameter 52 mm.

## PLATE 8.

- FIG. 1.—*Acteocina puruha* new species. Type, length 7.5 mm.  
FIG. 2.—*Semicassis centiquadrata* (Valenciennes). Length 47 mm.  
FIG. 3.—*Onoba fortis* new species. Type, length 3.8 mm.  
FIG. 4.—*Olivella gracilis* Broderip & Sowerby. Length 12.9 mm.  
FIG. 5.—*Olivella gracilis* Broderip & Sowerby. Length 12 mm.  
FIG. 6.—*Nassa pacis* new species. Type, length 17.8 mm.  
FIGS. 7, 11.—*Calliostoma nonurum* new species. Type, height 25.9 mm.  
FIG. 8.—*Nassa pacis* new species. Paratype, length 18.2 mm.  
FIG. 9.—*Porphyrobaphe iostoma bilabrata* Pilsbry. Length 53.5 mm.  
FIG. 10.—*Calliostoma nonurum* new species. Paratype, height 22.9 mm.

## PLATE 9.

- FIG. 1.—*Teinostoma ecuadorianum* new species. Type, height 0.9 mm.  
FIG. 2.—*Pseudorotella lens* new species. Type, length 0.7 mm.  
FIG. 3.—*Circulus occidentalis* new species. Type, height 0.9 mm.  
FIG. 4.—*Systellomphalus perornatus* new species. Type, height 1.2 mm.  
FIG. 5.—*Mangelia heptapleura* new species. Type, length 5.2 mm.  
FIG. 6.—*Mangelia hesperia* new species. Type, length 6 mm.  
FIGS. 7, 8.—*Nannodiella meridionalis* new species. Type, length 3.8 mm.  
FIG. 9.—*Mangelia ecuadoriana* new species. Type, length 3.2 mm.

## PLATE 10.

- FIG. 1.—*Aesopus (Glyptaesopus) perornatus* new species. Type, length 6.4 mm.  
FIG. 2.—*Aesopus (Glyptaesopus) perornatus* new species. Paratype, length 6.5.  
FIG. 3.—*Turbonilla (Mormula) loripana* new species. Paratype, length 13.4 mm.  
FIG. 4.—*Turbonilla (Mormula) loripana* new species. Type, length 13.8 mm.  
FIG. 5.—*Turbonilla (Mormula) loripana* new species. Paratype.  
FIG. 6.—*Aesopus (Glyptaesopus) polylophus* new species. Type, length 5.8 mm.  
FIG. 7.—*Caecum (Quadrulata) campe* new species. Type, length 5.5 mm.  
FIG. 8.—*Caecum (Quadrulata) campe* new species. Paratype, length 5.1 mm.  
FIGS. 9, 10.—*Cadulus (Polyschides) quitus* new species. Type, length 5.6 mm.  
FIG. 11.—*Cadulus (Gadilopsis) leptodoma* new species. Type, length 6.5 mm.

## PLATE 11.

- FIGS. 1, 2.—*Arca (Scapharca) hopkinsi* new species. Type, length 93 mm.  
FIG. 3.—*Turritella pasada* new species. Type, length 108 mm.  
FIG. 4.—*Turritella pasada* new species. Paratype, length 60.6 mm.

## PLATE 12.

- FIG. 1.—*Cyclinella galera* new species. Type, height 57.5 mm.  
FIG. 2.—*Donax punaensis* new species. Type, length 25 mm.  
FIGS. 3, 5.—*Corbula ecuabula* new species. Type, length 16.25 mm.  
FIG. 4.—*Corbula ecuabula* new species. Paratype, length 11.25 mm.  
FIG. 6.—*Cardium (Trigoniocardia) cabopasadam* new species. Paratype, greatest height (oblique) 33 mm.  
FIG. 7.—*Cardium (Trigoniocardia) cabopasadam* new species. Type, greatest height (oblique) 33 mm.  
FIG. 8.—*Crassinella clementia* new species. Type, length 4 mm.  
FIG. 9.—*Cardium (Trachycardium) ballenium* new species. Type, height 77 mm.

## PLATE 13.

- FIG. 1.—*Arca (Scapharca) ecuadoriana* new species. Type, length 48 mm.  
FIGS. 2, 2a.—*Glycymeris canoa* new species. Type, length 46 mm.  
FIG. 3.—*Arca (Scapharca) wheeleri* new species. Type, length 94 mm.  
FIG. 4.—*Arca (Cunearca) esmeralda* new species. Paratype, length 50 mm.  
FIG. 5.—*Arca (Cunearca) esmeralda* new species. Type, length 57 mm.

## PLATE 14.

- FIG. 1.—*Mactra (Micromactra) atacama* new species. Type, length 60.5 mm.  
FIG. 2.—*Laevicardium pedernalense* new species. Type, height 31.5 mm.  
FIG. 3.—*Mactra (Micromactra) atacama* new species. Paratype, length 50.4 mm.  
FIG. 4.—*Anomalocardia callistoides* new species. Paratype, length 40.5 mm.  
FIG. 5.—*Anomalocardia callistoides* new species. Type, length 43 mm.  
FIG. 6.—*Tellina (Macaliopsis) lyrice* Pilsbry & Lowe. Length 43 mm.  
FIG. 7.—*Tellina (Macaliopsis) aequizonata* new species. Type, length 55 mm.  
FIG. 8.—*Anomalocardia callistoides* new species. Paratype, length 41.2 mm.

## PLATE 15.

- FIGS. 1, 4.—*Tellina (Eurytellina) laplata* new species. Type, length 47 mm.  
FIGS. 2, 3.—*Tellina (Eurytellina) laplata* new species. Paratype, length 40.4 mm.  
FIG. 5.—*Tellina (Eurytellina) laplata* new species. Paratype, length 38.2 mm.  
FIG. 6.—*Tellina (Eurytellina) ecuadoriana* new species. Paratype, length 58 mm.  
FIG. 7.—*Tellina (Eurytellina) ecuadoriana* new species. Paratype, length 45.3 mm.  
FIG. 8.—*Tellina (Eurytellina) ecuadoriana* new species. Type, length 49 mm.  
FIG. 9.—*Macoma (Cymatoica)* species undetermined. Length 7.6 mm. (incomplete).  
FIG. 10.—*Pitar (Lamelliconcha) salanga* new species. Type, length 37 mm.  
FIG. 11.—*Pitar (Lamelliconcha) salanga* new species. Paratype, length 35 mm.

## PLATE 16.

- FIG. 1.—*Chione manabita* new species. Paratype, length 52 mm.  
FIG. 2.—*Chione (Lirophora) kelletti* (Hinds). Length 40.5 mm.  
FIG. 3.—*Chione manabita* new species. Type, length 94.5 mm.  
FIG. 4.—*Chione traftoni* new species. Type, length 52 mm.  
FIGS. 5, 5a.—*Chione venadensis* new species. Type, length 32.5 mm.

## PLATE 17.

- FIG. 1.—*Chione jamaniana* new species. Type, length 76 mm.  
FIG. 2.—*Chione jamaniana* new species. Paratype.  
FIG. 3.—*Lucina (Lucinisca) fausta* new species. Paratype, length 25 mm.  
FIG. 4.—*Chione traftoni* new species. A.N.S.P. 14488, length 57 mm.  
FIG. 5.—*Semele jaramija* new species. Type, length 21 mm.  
FIG. 6.—*Lucina (Lucinisca) fausta* new species. Type, length 33 mm.

## PLATE 18.

- FIG. 1.—*Panopea cf. coquimbensis* d'Orbigny. Length 90 mm.  
FIGS. 2, 3.—*Crenella ecuadoriana* new species. Type, length 3.3 mm.  
FIG. 4.—*Solecurtus broggi* new species. Type, length 84 mm.  
FIG. 5.—*Tagelus (Mesopleura) peruvianus* new species. Type, length 85 mm.  
FIG. 6.—*Lucina (Parvilucina) callosana* new species. Type, length 2.8 mm.  
FIG. 7.—*Crassinella haylocki* new species. Paratype, length 2.8 mm.  
FIG. 8.—*Crassinella haylocki* new species. Type, length 2.6 mm.

## PLATE 19.

- FIG. 1.—*Pecten (Janira) sericeus* Hinds (?). 72.3 mm. from umbo to the most distant point on the broken margin.  
FIG. 2.—*Chione (Lirophora) gorgona* new species. Type, length 37 mm.  
FIGS. 3, 8.—*Mulinia guayasensis* new species. Type, length 50 mm.  
FIG. 4.—*Cyclinella galera* new species. Type, height 57.5 mm.  
FIG. 5.—*Macoma (Macoploma) ecuadoriana* new species. Type, length 61 mm.  
FIG. 6.—*Mulinia camina* new species. Type, length 27.5 mm.  
FIG. 7.—*Mulinia camina* new species. Paratype, length 28 mm.



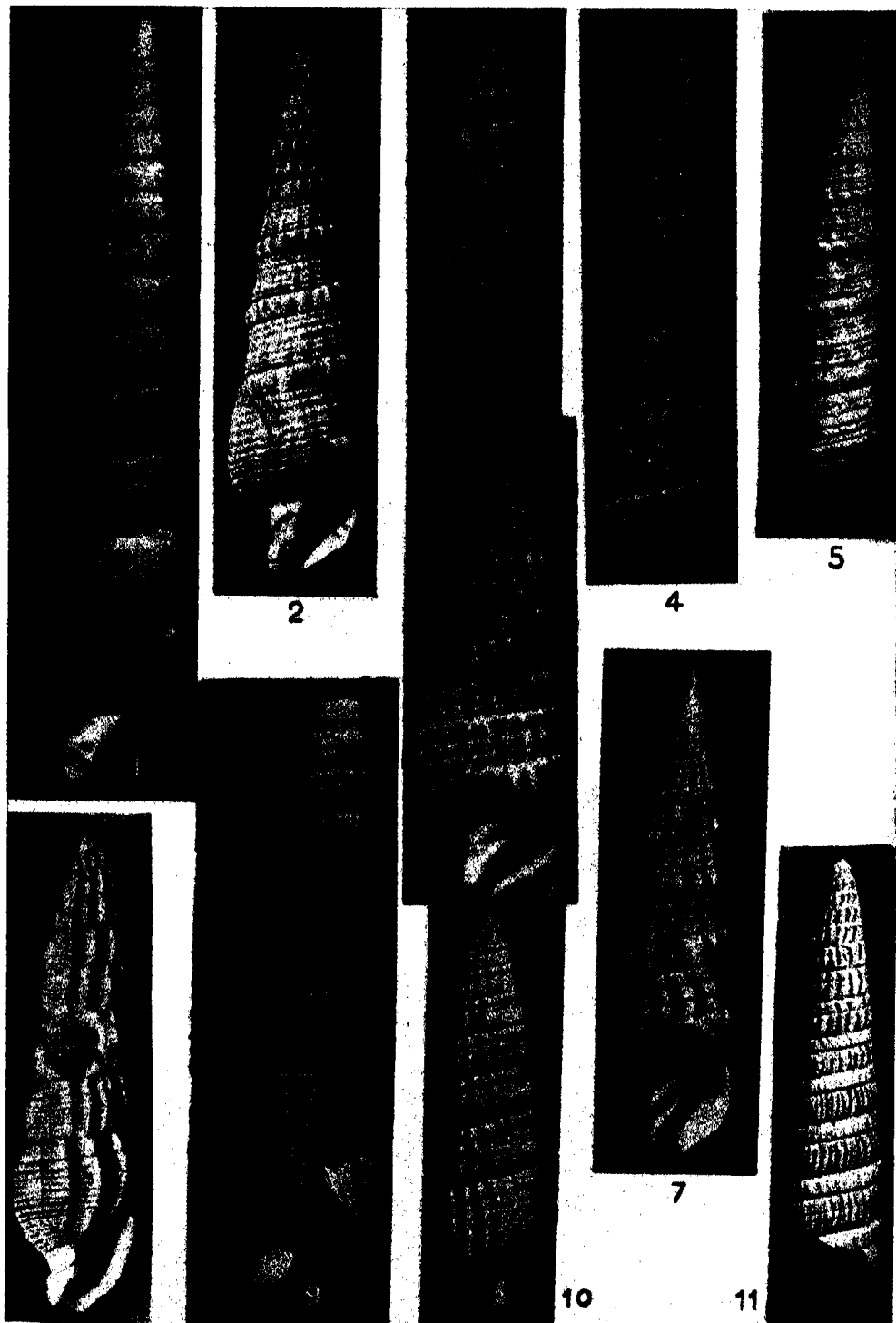


PILSBRY AND OLSSON: A PLIOCENE FAUNA FROM WESTERN ECUADOR

UPPER FIGURE.—Punta Blanca. The greater part of this bluff is formed by the nearly horizontal sand and clay beds of the Canoa formation (Pliocene) resting strongly unconformable on north-dipping concretionary Oligocene shales (Manta Formation). The contact is plainly shown in the lower part of the bluff.

LOWER FIGURE.—Punta Blanca. In this view, the nearly level beds of the Pliocene are again seen overlying the Oligocene shale with concretions. The basal bed of the Pliocene, indicated by the white band near the base of the bluff, is highly fossiliferous (Zone J).

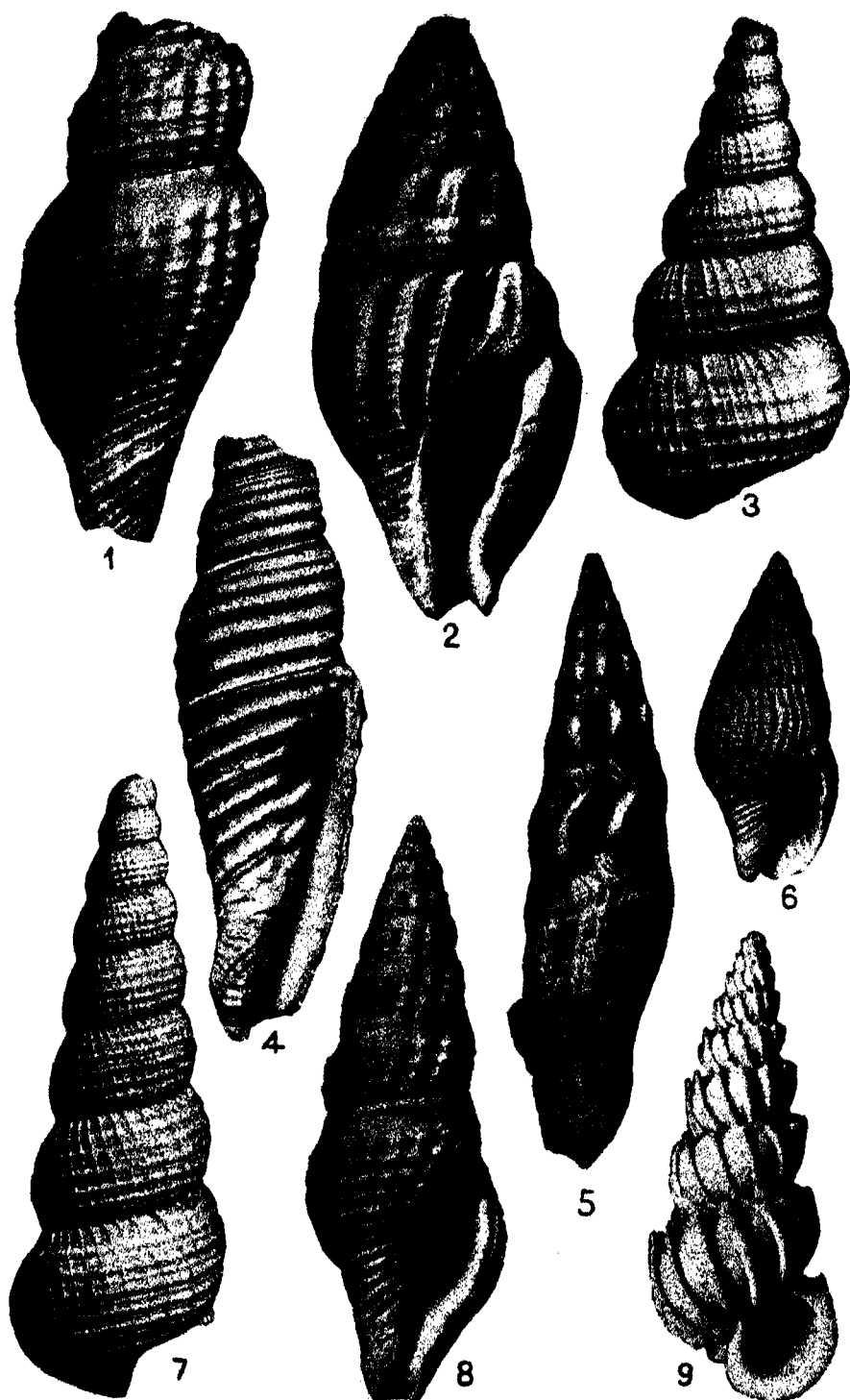




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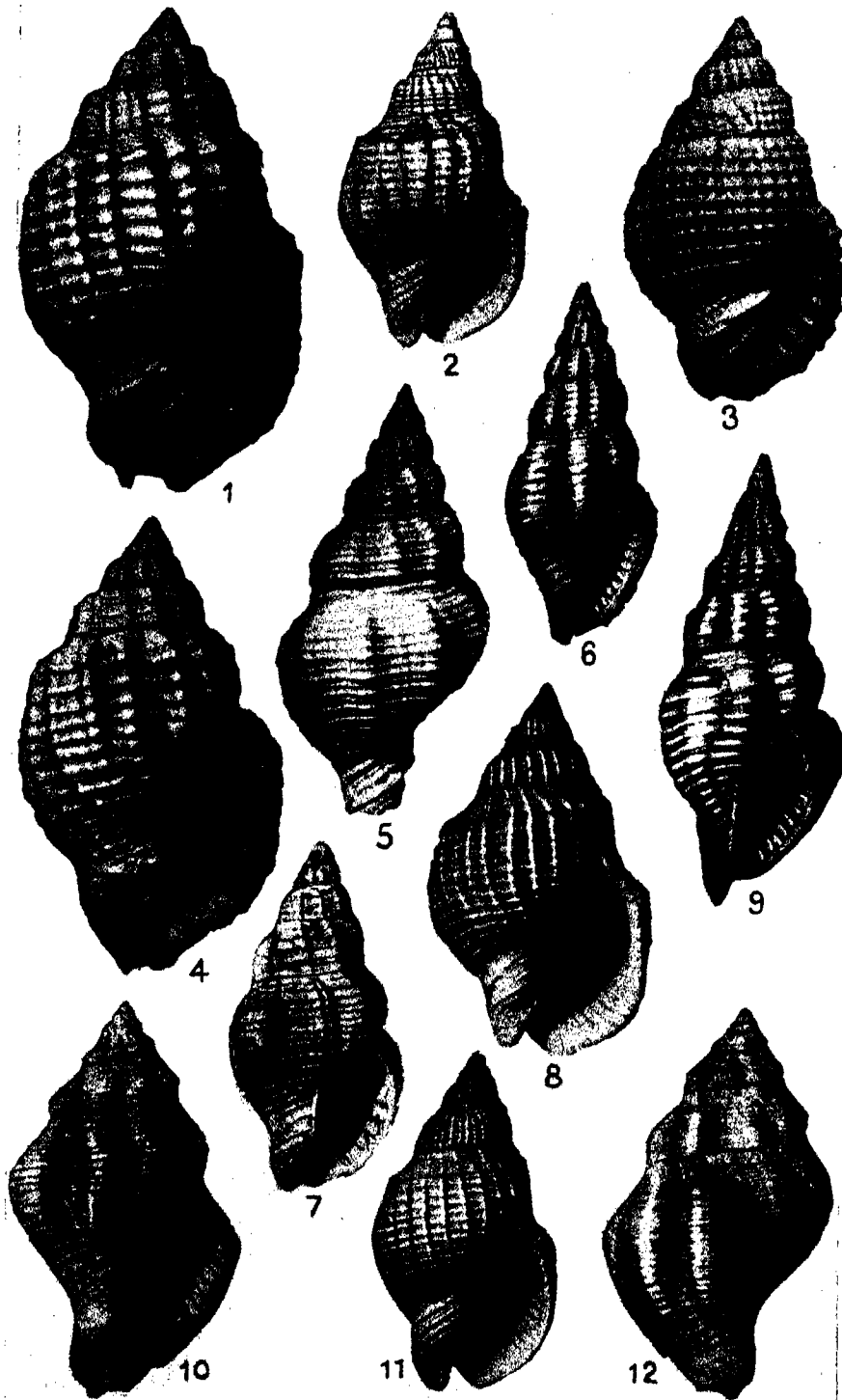
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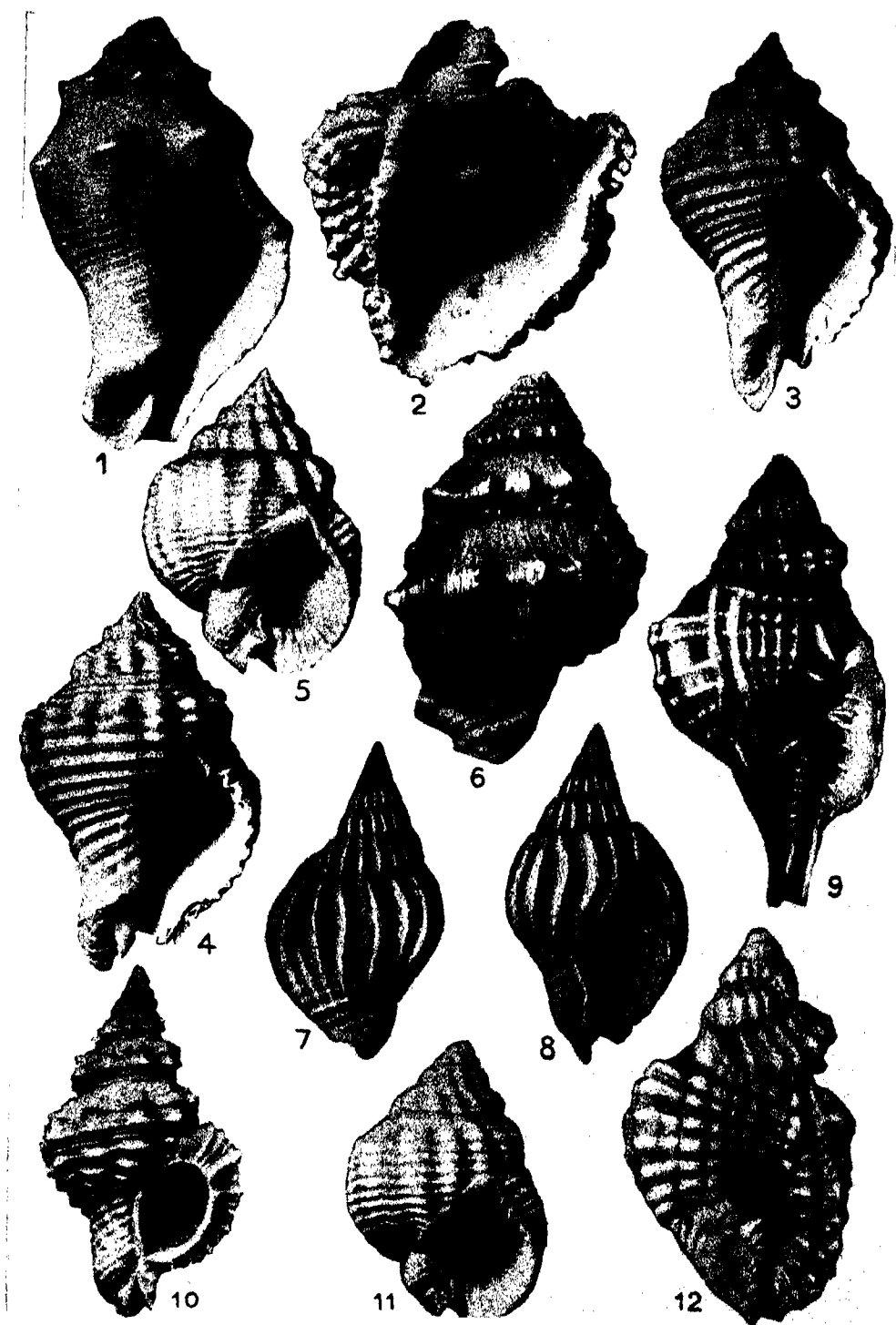
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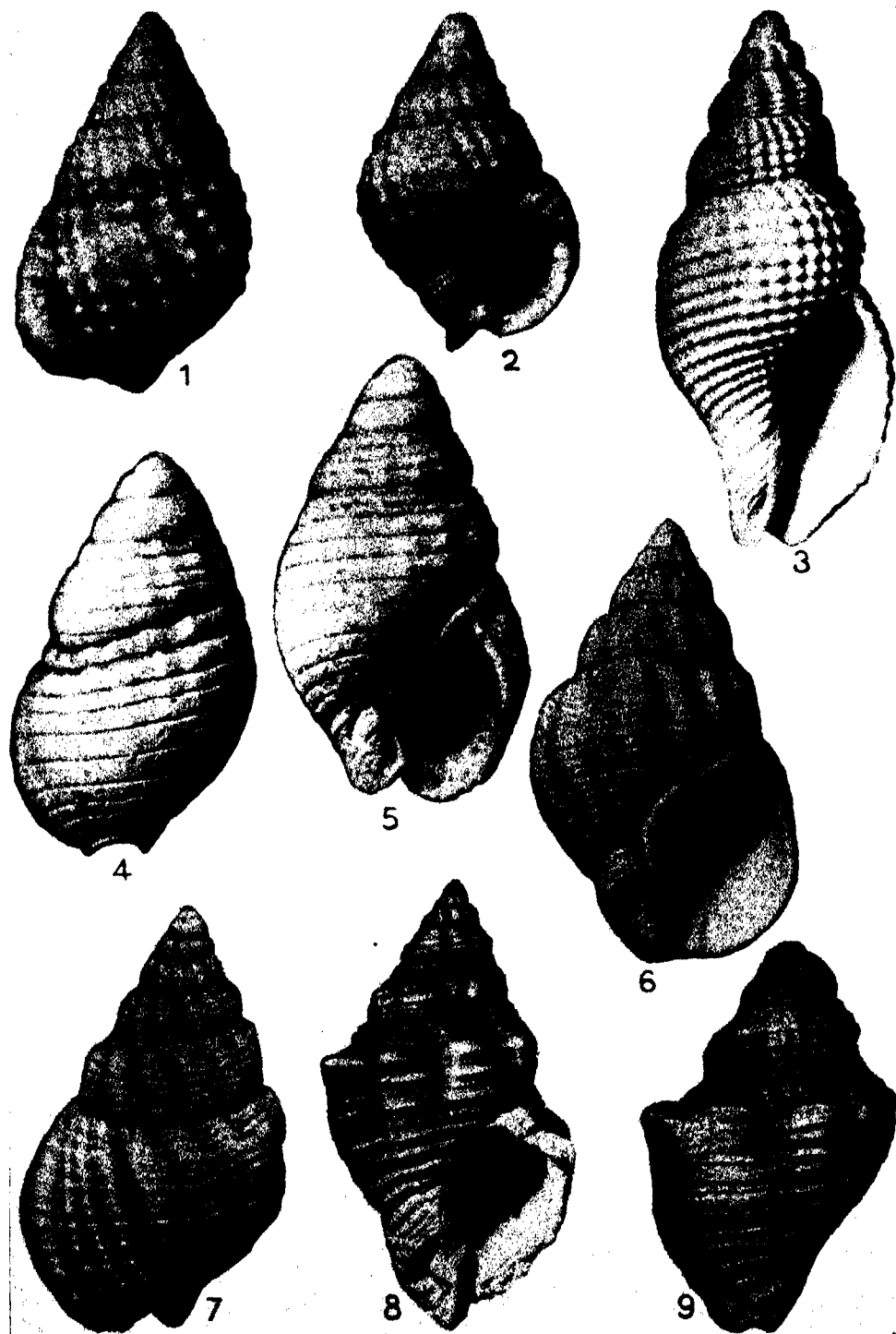




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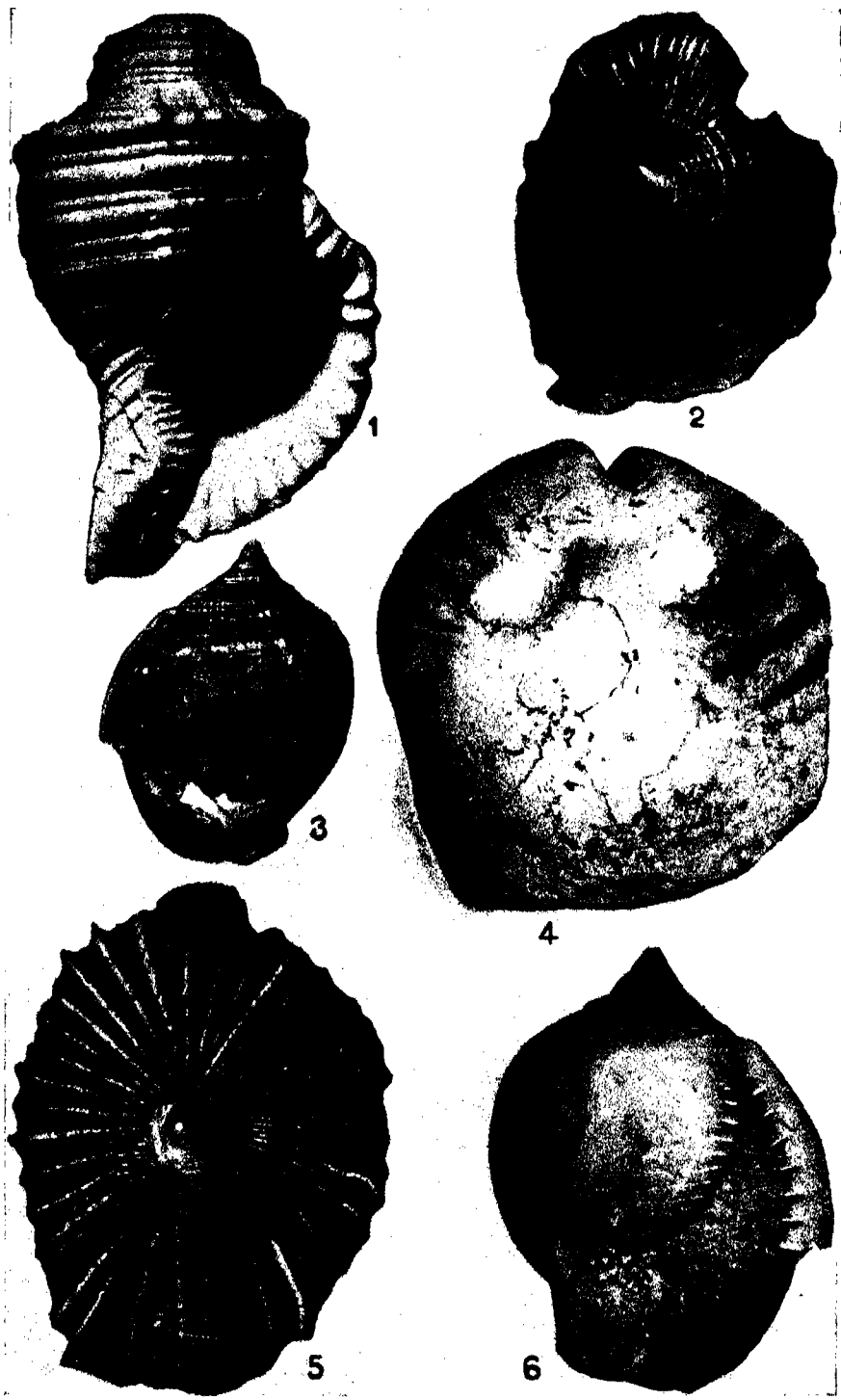






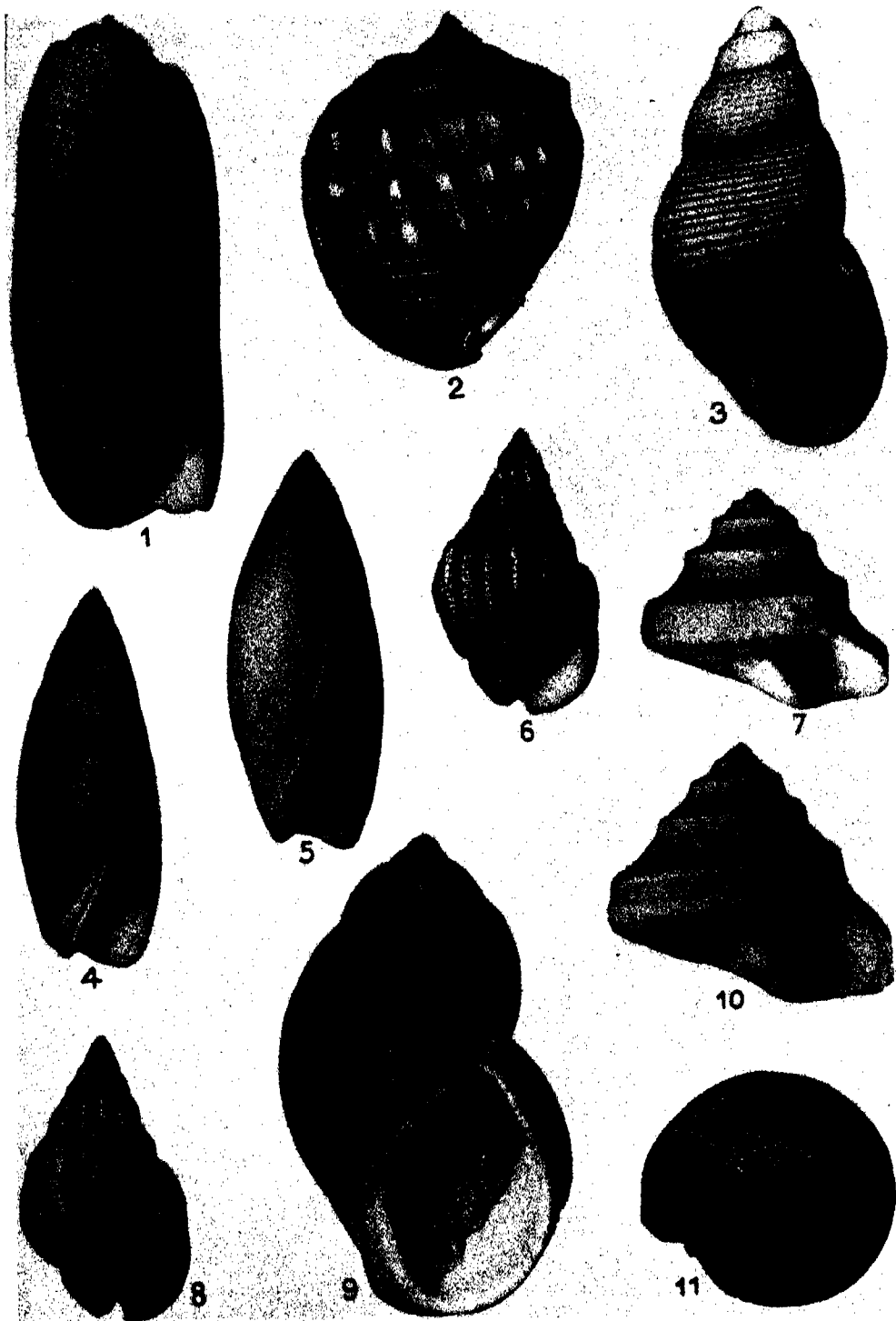
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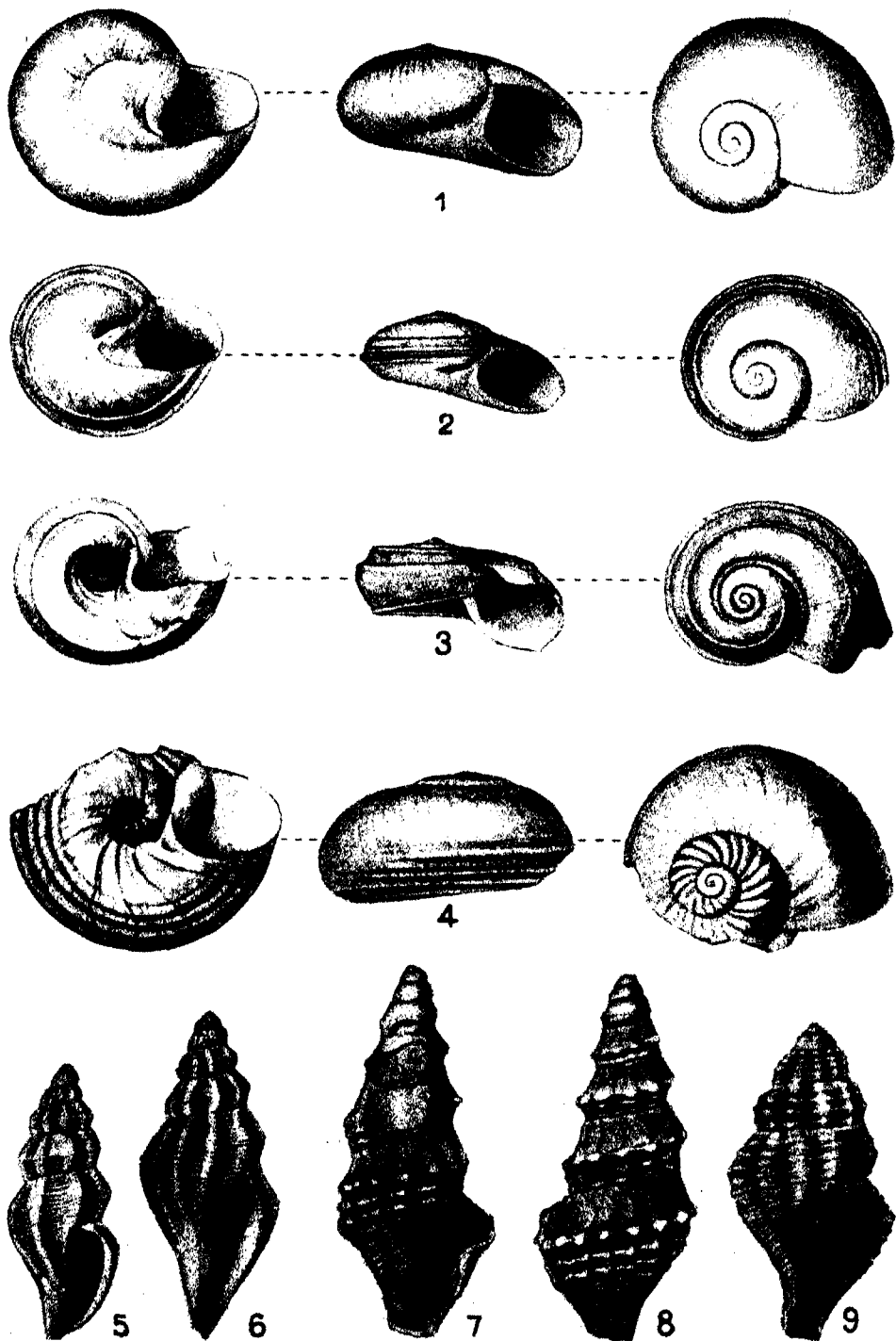
PILSBRY AND OLSSON: A PLIOCENE FAUNA FROM WESTERN ECUADOR





PILSBRY AND OLSSON: A PLEISTOCENE FAUNA FROM WESTERN ECUADOR

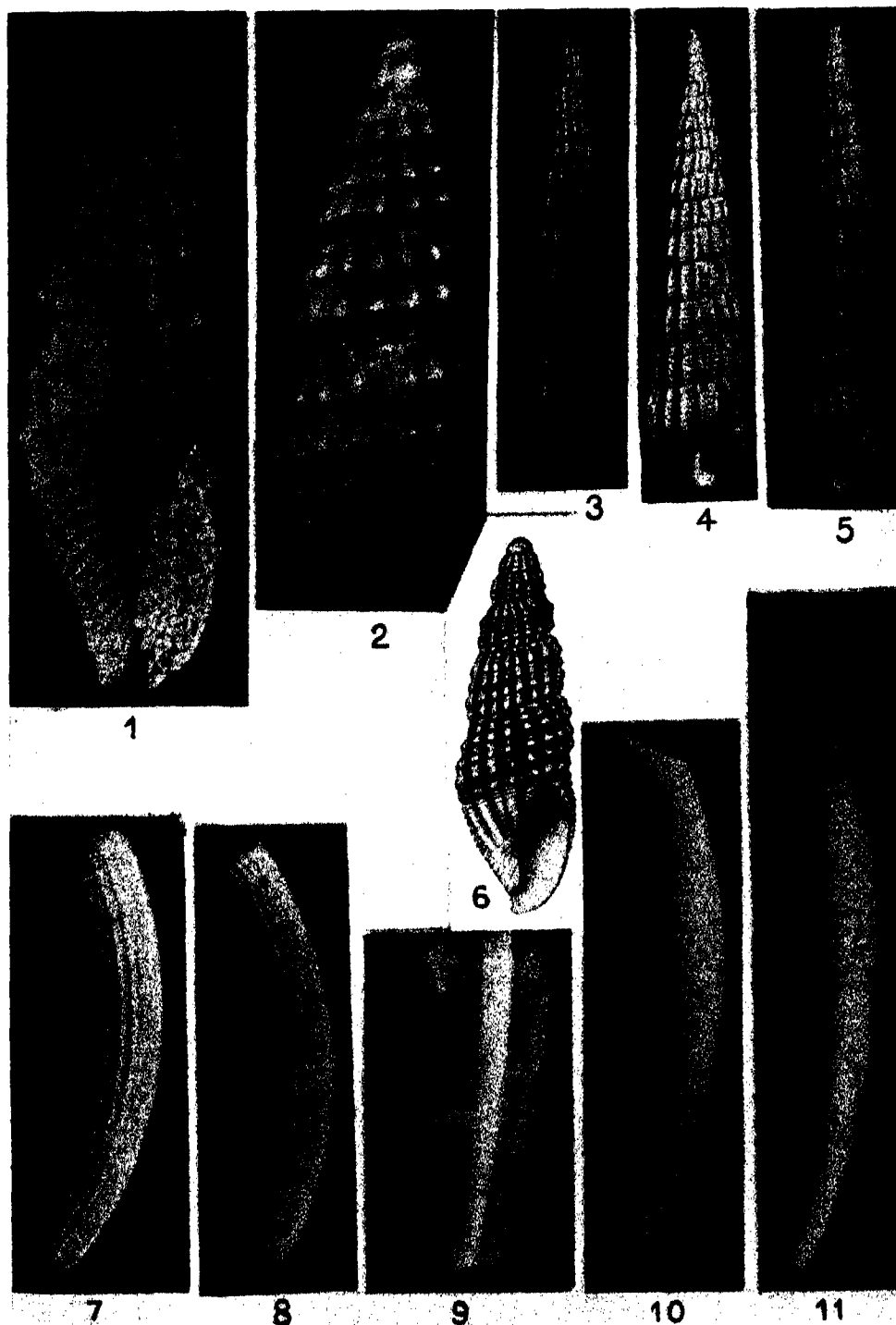




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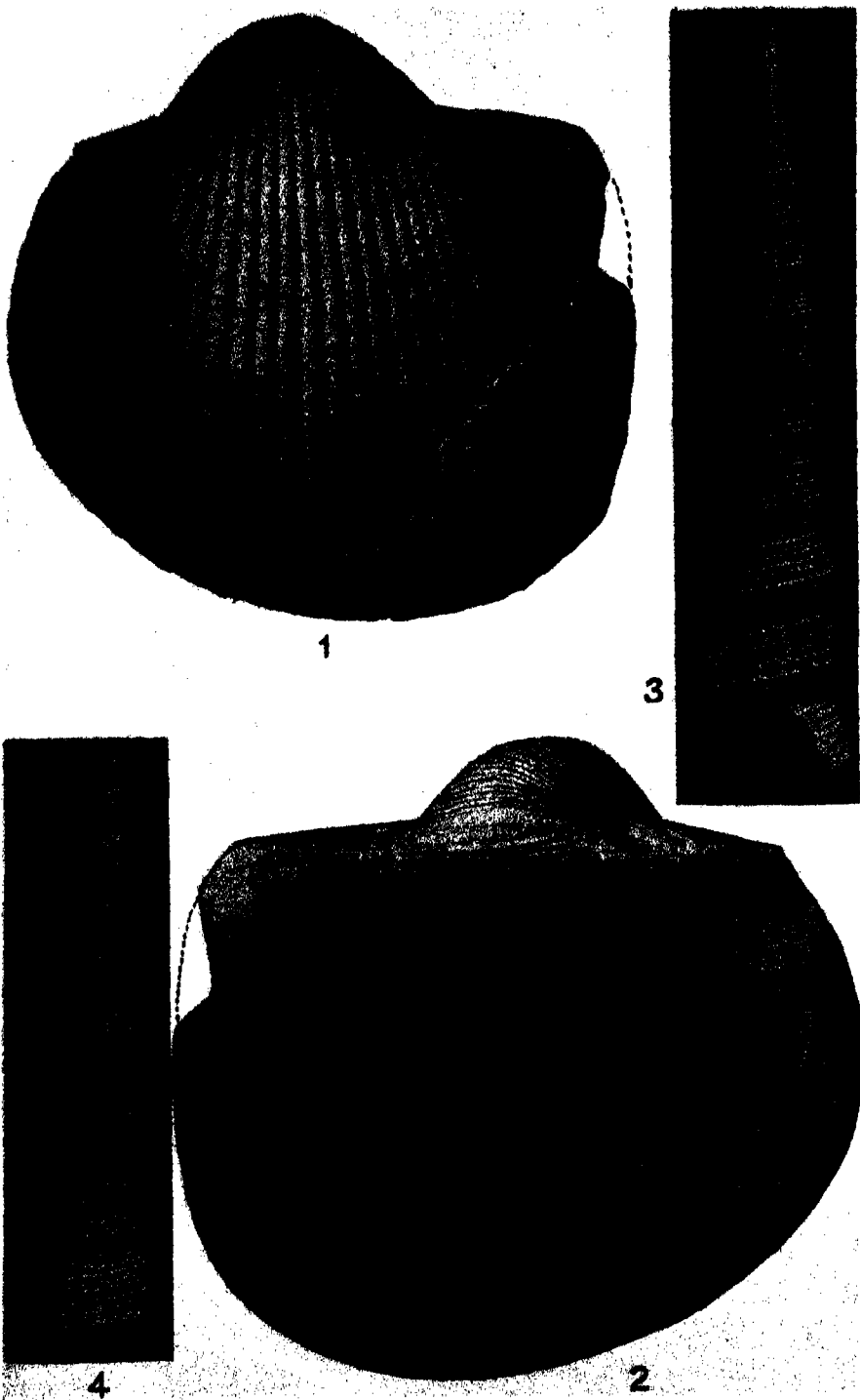






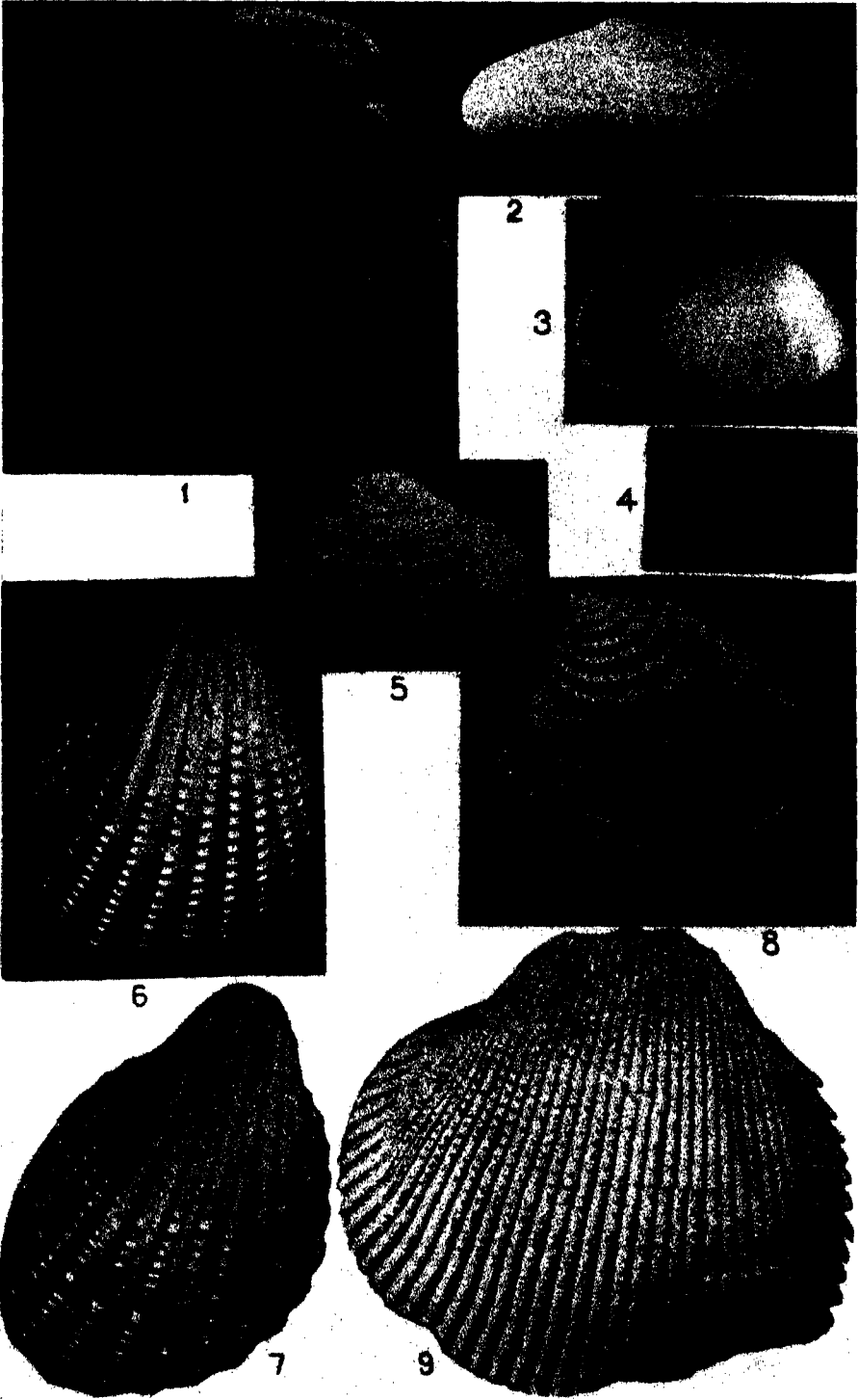
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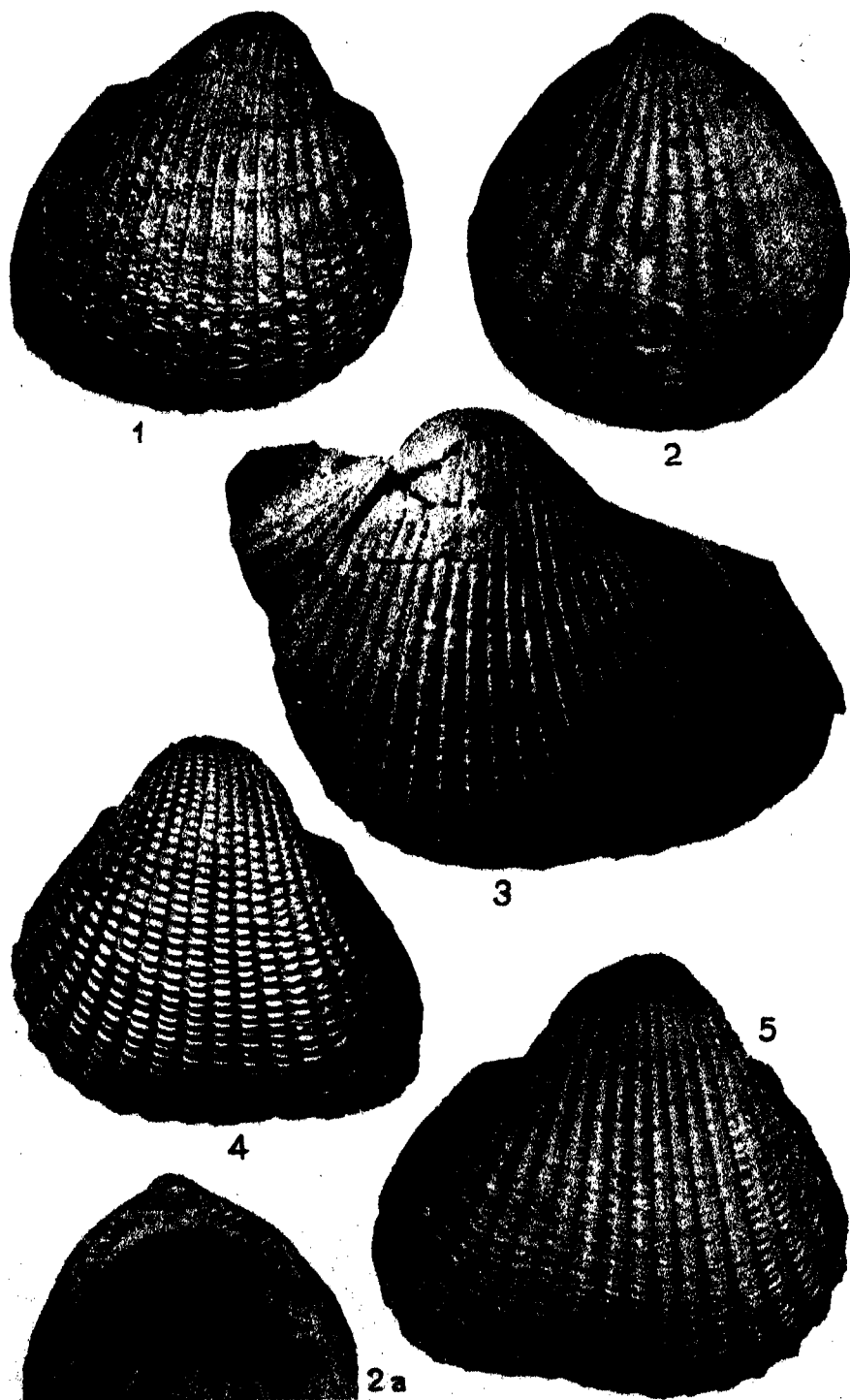
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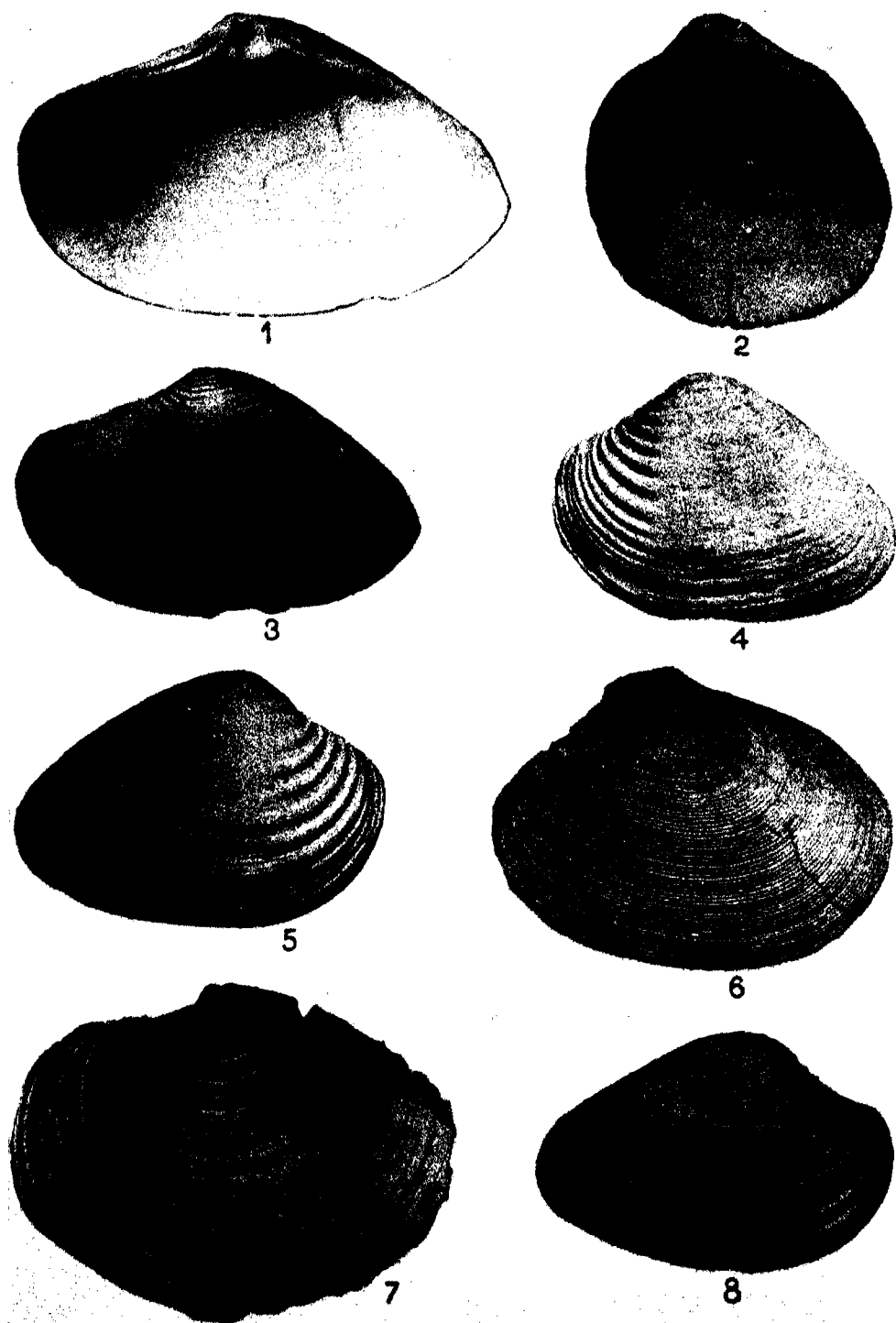




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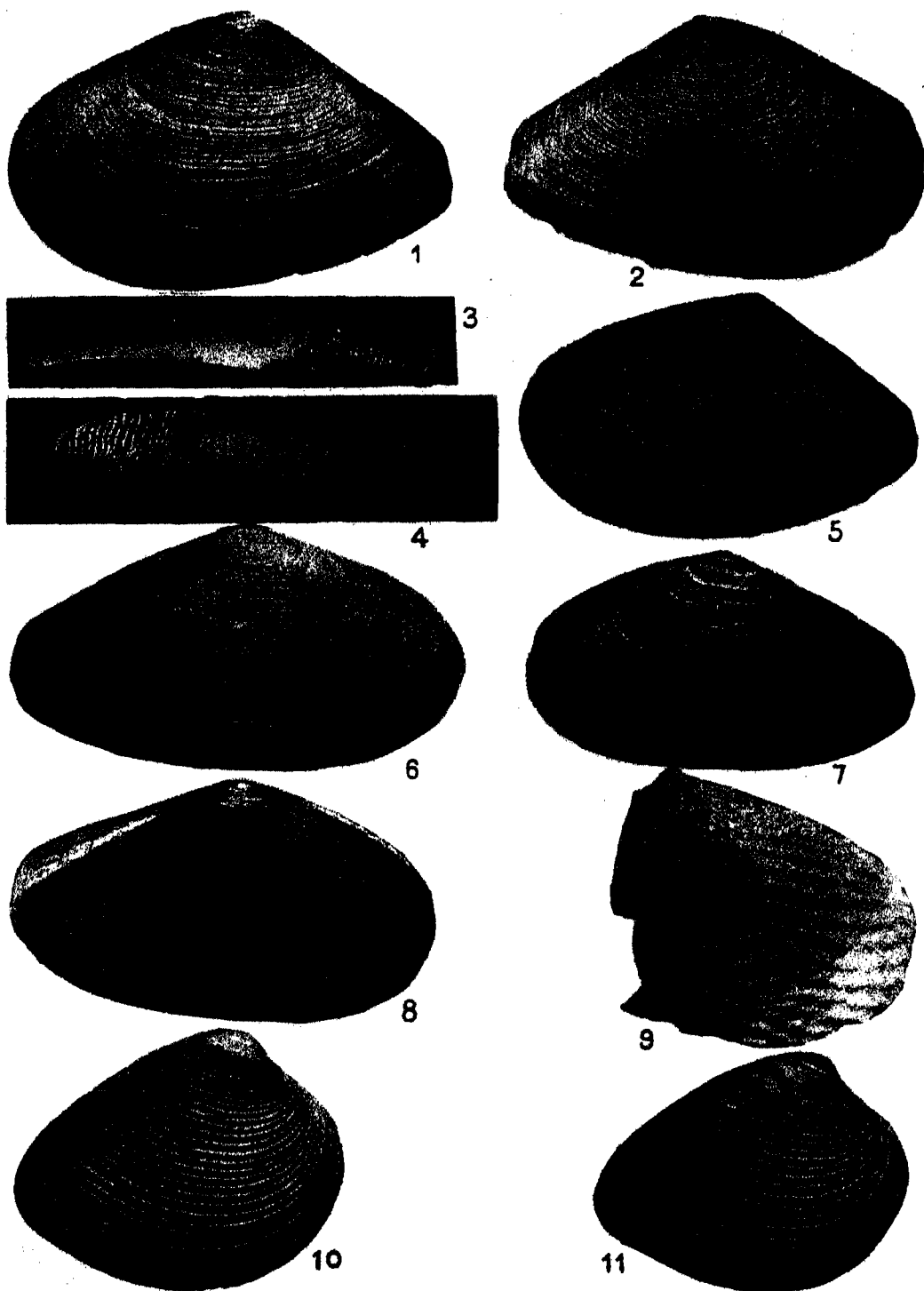






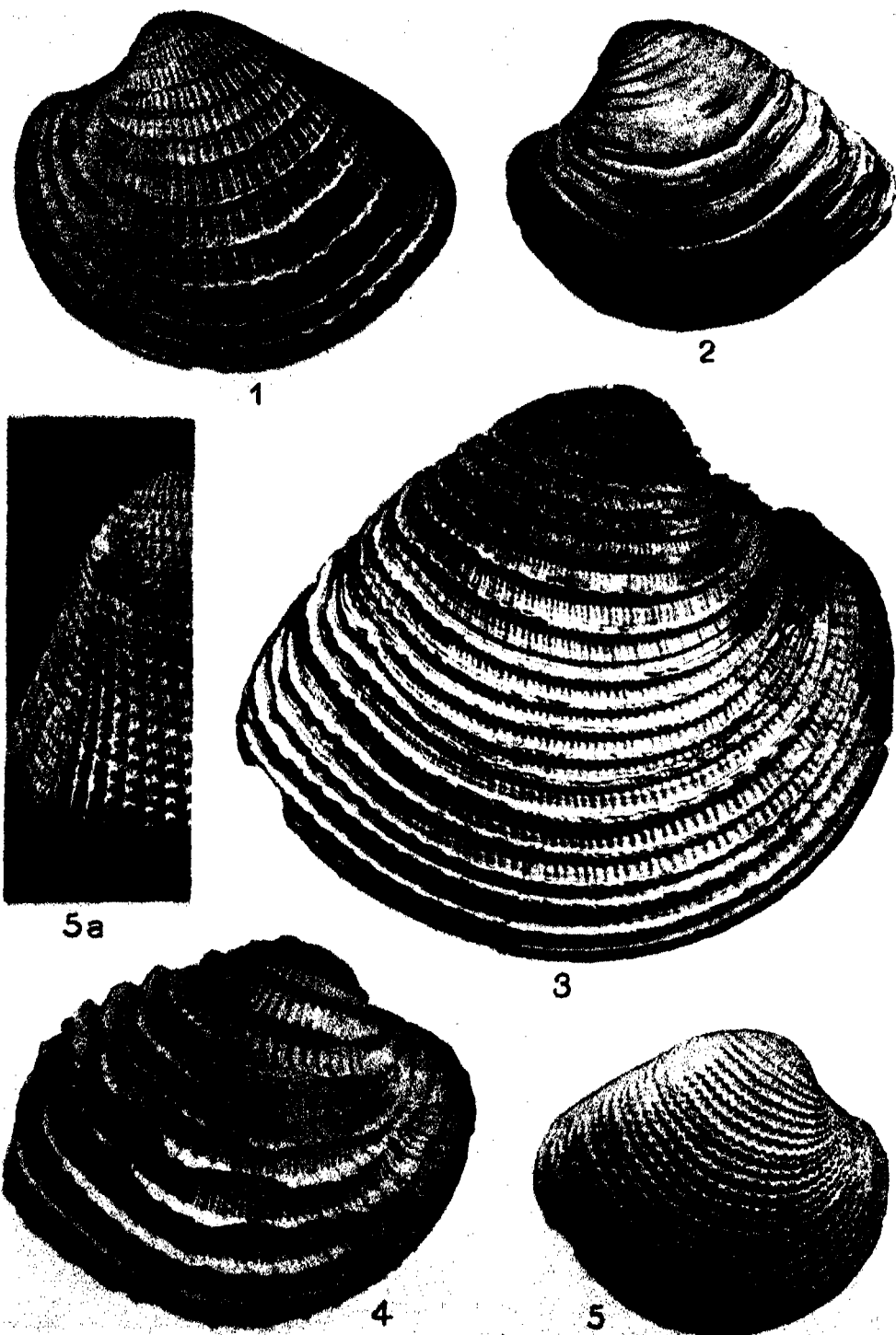
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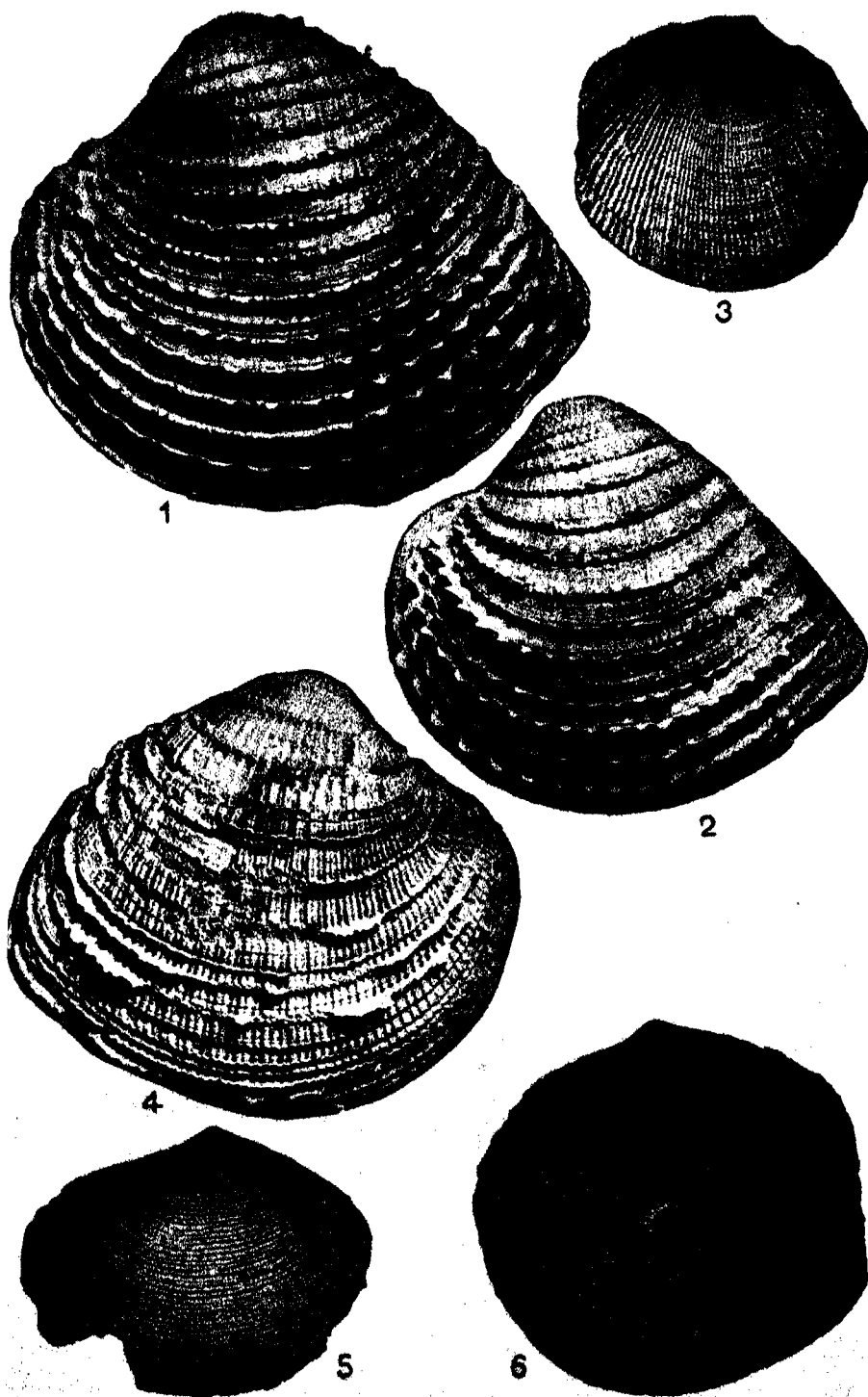
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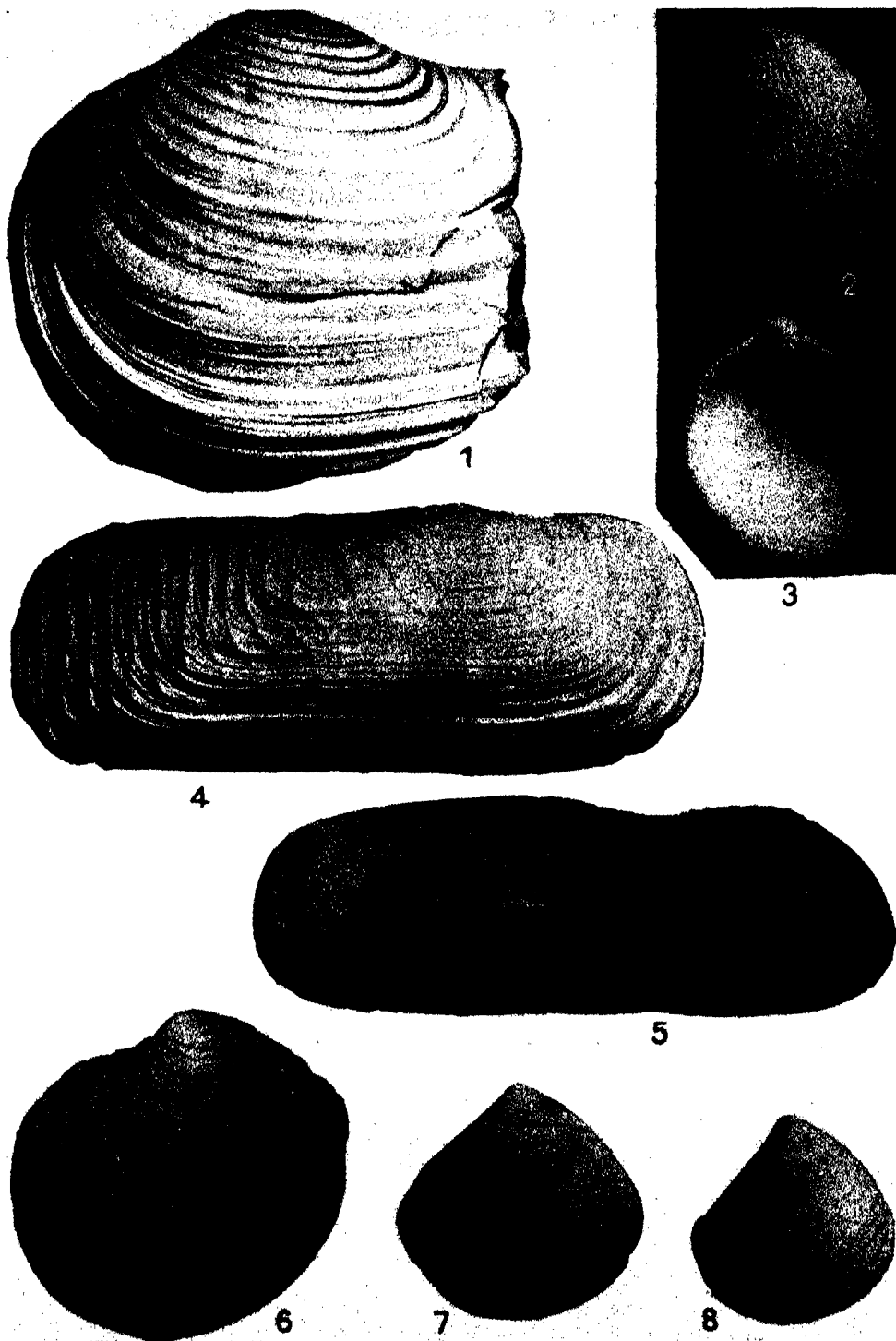




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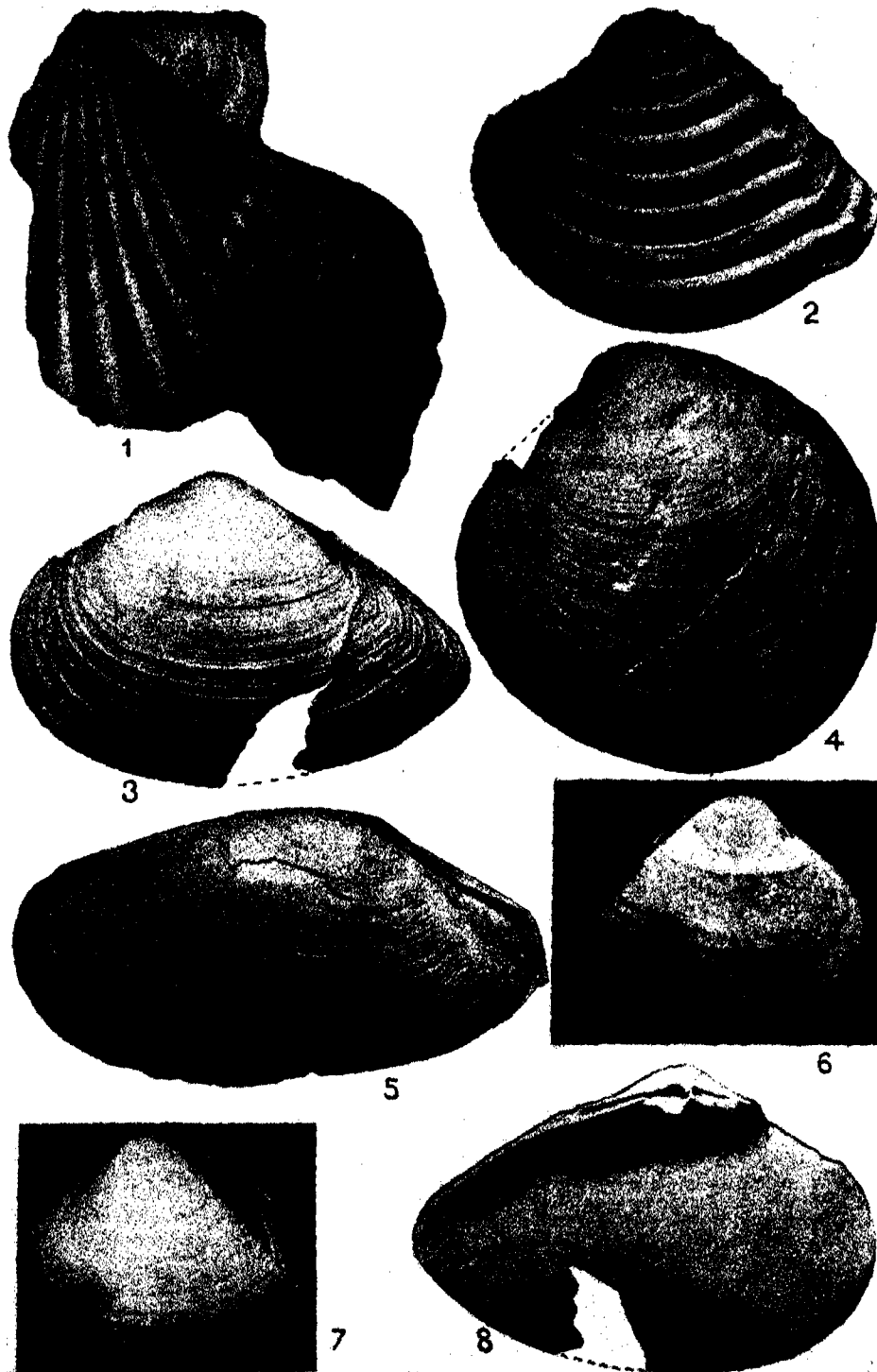






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## NOTES ON FLORIDA FISHES WITH DESCRIPTIONS OF SEVEN NEW SPECIES

BY HENRY W. FOWLER

*Curator of Fishes, The Academy of Natural Sciences of Philadelphia*

The collections here reported were presented by a number of friends of the Academy. The most extensive were made by Mrs. Frank R. Schwengel, while dredging chiefly for mollusca and invertebrates, during the early winter and spring of 1940. Mrs. Schwengel collected, prepared, and shipped the fishes to the Academy, the several lots received numbered altogether 168 specimens representing 59 species. Besides the 6 new forms, others are of interest for new records in geographic distribution. The localities given on the labels are as follows:

1. Sanibel, Lee County, January.
2. Eight miles off Naples in 5 fathoms, April.
3. Ten miles off Naples in 6 fathoms, April.
4. Between Naples and Marco, 15 miles off shore in 6 fathoms, April.
5. Off Little Shark River in 2 fathoms, April 8.
6. Off Howe Key in  $1\frac{1}{2}$  fathoms, April 8.
7. Between Johnson Key and Key West in 2 to  $3\frac{1}{2}$  fathoms, April 8.
8. Off Johnson Key in 2 fathoms, April 8.
9. Main Channel south of Key West in 19 fathoms, April 10.
10. Sand Key in 40 fathoms, April 10 and 11.
11. Off Key West south in 19 fathoms, April 12.
12. Two miles off Boca Chica Key in 1 to 5 fathoms, April 14.
13. Off American Shoal in  $5\frac{1}{2}$  fathoms, April 16.
14. Off Pacific Reef in 45 to 50 fathoms, April 21.
15. Off Miami Beach in  $8\frac{1}{2}$  fathoms, April 22.
16. Off Boynton in 19 fathoms, April 24.

Credit is due Mrs. Schwengel for the excellent state of preservation of the material as well as for her discrimination and labor in forming this important gift to the Academy.

An interesting tide pool collection was prepared and brought to the Academy by Dr. Baldouin Lucké of the Laboratory of Pathology of the University of Pennsylvania, while at the Dry Tortugas in July 1937. It embraces 91 specimens representing 22 species, of which a scorpaenid is described as new. This material is especially welcome as showing many

early stages in the development of certain species. A few specimens were also received from Mr. Samuel Bell 3rd, obtained at Cocoanut Grove on Biscayne Bay. Dr. Henry A. Pilsbry, and Mr. Richard A. McLean, both of the Academy staff, presented the specimens credited to them in the following account.

Several references are given for a few little-known species, or those having involved synonymy.

#### **BRANCHIOSTOMIDAE**

***Branchiostoma floridae*** Hubbs

Eight, 37 to 57 mm., Sanibel.

#### **TORPEDINIDAE**

***Narcine brasiliensis*** (Olfers)

Two, 128 to 255 mm., Sanibel.

#### **MYRIDAE**

***Myrophis punctatus*** Lütken

Two, 262 to 291 mm., South Inlet, Lake Worth, 1940 (Dr. H. A. Pilsbry).

#### **OPHICHTHYIDAE**

***Bascanichthys teres*** (Goode and Bean)

One, 535 mm., Sanibel. Differs from the outline drawing by Storey which shows the combined tail and trunk of equal length, and the gill opening as vertical. My specimen is with the anterior part of the dorsal white.

***Mystriophis intertinctus*** (Richardson)

Three, 254 to 335 mm., Sanibel.

#### **TACHYSURIDAE**

***Galeichthys felis*** (Linnaeus)

One, 101 mm., Sanibel. From gullet of largest *Mystriophis intertinctus*.

#### **SYNODONTIDAE**

***Trachinocephalus myops*** (Schneider)

One, 100 mm., off Boca Chica.

***Synodus foetens*** (Linnaeus)

One, 112 mm., Tortugas; one, 38 mm., off Boca Chica.

**BELONIDAE*****Strongylura notata* (Poey)**

One, 47 mm., Cocoanut Grove, Biscayne Bay, April 17, 1939 (Samuel Bell 3rd); one, 377 mm., Sanibel.

**HEMIRAMPHIDAE*****Hyporhamphus unifasciatus* (Ranzani)**

One, 34 mm., Cocoanut Grove, Biscayne Bay, April 3, 1939 (Samuel Bell 3rd).

**EXOCOETIDAE*****Parexocoetus brachypterus hillianus* (Gosse)**

One, 68 mm., near Bahia Honda, late May 1938 (David F. Williams 3rd).

***Cypsilurus furcatus* (Mitchill)**

Two, 31 to 37 mm., Miami, Biscayne Bay, February 1938 (Samuel Bell 3rd).

**BREGMACEROTIDAE*****Bregmaceros atlanticus* Goode and Bean**

Nine, 39 to 57 mm., off main channel south of Key West; two, 52 to 55 mm., off American Shoals, in 25 fathoms, April 15.

**BOTHIDAE*****Bothus ocellatus* (Agassiz)**

One, 91 mm., between Naples and Marco; three, 20 to 32 mm., off main channel south of Key West; four, 27 to 60 mm., off Key West south; one, 50 mm., off Boca Chica; two, 28 to 57 mm., off Miami Beach; two, 28 to 53 mm., off Boynton.

**ACHIRIDAE*****Achirus achirus* (Linnaeus)**

One, 95 mm., Sanibel. Caudal quite pale or whitish, like broad outer margins of dorsal and anal.

**CYNOGLOSSIDAE*****Symphurus plagiatus* (Linnaeus)**

One, 53 mm., off Key West south; one, 135 mm., off American Shoal.



**SYNGNATHIDAE****Syngnathus louisianae** Günther

One, 296 mm., Sanibel. Rings 21+36, D. 32, on 2+5 rings.

**Syngnathus mackayi** (Swain and Meek)

One, 144 mm., Sanibel; one, 191 mm., off Boca Chica. D. 30 to 33, on 1 or 2+6 or 7 rings. Rings 16 or 17+34 or 35. Sanibel specimen largely dark gray-black, may have changed color in preservative. Boca Chica specimen male, greenish brown, with numerous, very fine close-set whitish lines longitudinally with many broken as minute white dots or spots, especially below. Brood pouch white, with dark brown lines forming minute white dots or spots. Also 3 females, 190 to 240 mm., from Sanibel.

**Syngnathus elucens** Poey

Seven, 85 to 118 mm., Tortugas.

**Anarchopterus criniger** (Bean and Dresel)

One, 91 mm., Sanibel. *Simosyngnathus* Fowler 1940 proposed as a recent new generic name for this pipefish is precluded by *Anarchopterus* Hubbs 1935. Subsequent specimens from Lemon Bay show the many cutaneous flaps, though very small and hardly visible without a lens.

**Hippichthys albirostris** (Heckel)

Three, 138 to 162 mm., off Howe Key.

**Hippichthys brachycephalus** (Poey)

One, 81 mm., Tortugas. Male with brood pouch on second to nineteenth caudal rings. Many short cutaneous flaps on the occipital and opercular ridges of the head, shoulder girdle, dorsal, lateral, and ventral body keels, and on the upper and lower tail ridges.

**Hippocampus hudsonius punctulatus** Guichenot

Two, 127 to 148 mm., off Howe Key; two, 175 to 222 mm., Sanibel; two, 70 to 75 mm., off Naples.

**ATHERINIDAE****Membras vagrans** (Goode and Bean)

Two, 35 to 50 mm., Coconut Grove, Biscayne Bay, February 1938 (Samuel Bell 3rd).

**ISTIOPHORIDAE****Istiophorus albicans** (Latreille)

*Makaira albicans* Latreille, Nouv. Dict. Hist. Nat., Paris, ed. 1, vol. 24, March 7, 1804, p. 104 (on *le Makaira blanchatre* Bose, op. cit., vol. 13, Aug. 12, 1803, p. 558, type locality, Brazil; based on Marcgrave).

*Istiophorus albicans* Whitley, Rec. Austral. Mus., vol. 20, no. 1, 1937, p. 16 (reference).

One 65 mm., Cocoanut Grove, Biscayne Bay, May 28, 1936 (Samuel Bell 3rd). "Scooped out by a man near shore with his hat, the little fish seen by its bright shining colors as it swam by."

The above name for this species is accepted from Whitley, in place of the later *Histiophorus americanus* Cuvier 1831. Several unnecessary names, based on photographs by anglers in Florida, are hardly even synonyms, and seem to represent the present species. They are *Istiophorus wrighti* Jordan and Evermann 1926, *Istiophorus maguirei* Jordan and Evermann 1926, and *Istiophorus volador* Jordan and Evermann 1926.

#### CARANGIDAE

*Caranx bartholomaei* Valenciennes

One, 49 mm., Sand Key. Depth  $2\frac{1}{2}$ . Lower gill rakers 17. D. I, VIII, I, 28; A. II-I, 23. No dark opercular spot.

#### NOMEIDAE

*Nomeus albula* (Meuschen)

Two, 26 to 95 mm., Cocoanut Grove, Biscayne Bay, from under *Physalia* April 23, 1939 (Samuel Bell 3rd).

#### APOGONIDAE

*Apogon pigmentarius* (Poey)

Color in alcohol dark reddish or carmine brown, due to each scale marked with several dark to blackish pigment spots, also all crowded over median area of head and body, and smaller and less distinct to absent on edges of body where rose tints predominate. Whole side of head, breast and belly bright or brilliant violaceous, with greenish and purplish reflections. Pigmentation of head much darker and in contrast with rest of body. Blackish bar inclined from lower hind eye edge down over cheek behind maxillary. Vertical black blotch at junction of caudal base and caudal peduncle medially. Iris dark gray-black, with pale horizontal line above and another parallel below pupil. First dorsal dark gray, marked with numerous, variable gray-black dots or small spots. Soft dorsal and anal rose-carmine, both with narrow basal band of blackish spots, not subbasal. Caudal dull brown, dusted with dark gray-brown, nearly blackish posteriorly. Paired fins salmon color.

One, 60 mm., off Sand Key; one, 54 mm., American Shoals. The unsigned figure published by Jordan and Evermann differs in the truncate caudal (in both my specimens forked) and absence of the black basal caudal blotch. The figure of *Amia gloverensis* Breder<sup>1</sup> agrees largely, though is shown with a dark partly subbasal band on the second dorsal, while that on the anal is basal. This feature is stressed by Parr in his

<sup>1</sup> Bull. Bingham Oceanogr. Collection, vol. 1, art. 1, 1927, p. 36, fig. 19 (type locality, Washerwoman Cut, Bahamas; Grand Cayman).

distinctions for the two species, though his figure of *Amia pigmentarius* shows a shaded anal base. The disposition of the dark pigment spots would hardly appear to me to be of any importance specifically.

**Apogon punctulatus** (Poey)

One, 47 mm., Tortugas; one, 43 mm., off Key West south; one, 48 mm., off Miami Beach.

**SERRANIDAE**

**Serranus maculosus** Cuvier

One, 53 mm., off Boynton. Lower gill rakers 14. D. XI, 16, 1; A. III, 8, 1.

**Centropristis philadelphicus** (Linnaeus)

One, 38 mm., in from American Shoal.

**Hypoplectrus unicolor** (Walbaum)

Five, 53 to 59 mm., Tortugas.

**Prionodes phoebe** (Poey)

One, 50 mm., Sanibel.

**Eudulus subligarius** (Cope)

Six, 36 to 68 mm., Sanibel.

**Diplectrum formosum** (Linnaeus)

One, 46 mm., Looe Key, in 2½ fathoms, April 17; one 70 mm., Sanibel.

**LUTJANIDAE**

**Lutjanus griseus** (Linnaeus)

One, 67 mm., Cocoanut Grove, Biscayne Bay, February 20, 1939 (Samuel Bell 3rd).

**Ocyurus chrysurus** (Bloch)

Four, 50 to 90 mm., Tortugas.

**SPARIDAE**

**Calamus penna** (Valenciennes)

Fifteen, 48 to 93 mm., Tortugas.

**GERRIDAE**

**Eucinostomus californiensis** (Gill)

Three, 58 to 83 mm., Tortugas.

**MULLIDAE**

*Pseudupeneus maculatus* (Bloch)

Nine, 57 to 111 mm., Tortugas.

**CHAETODONTIDAE**

*Chaetodon ocellatus* Bloch

Two, 28 to 33 mm., Tortugas.

**SCORPAENIDAE**

*Scorpaena brasiliensis* Cuvier

Four, 33 to 104 mm., Sanibel, one of medium specimens alive "bright red and green" and another "dark red and gray"; two, 45 to 50 mm., off Johnson Key; three, 45 to 68 mm., between Johnson Key and Key West, with more or less rose on head, dorsals and pectoral, also iris rose above; one, 68 mm., off Boca Chica.

*Scorpaena dispar* Longley and Hildebrand

One, 20 mm., off Boynton, in 9 fathoms.

*Scorpaena luckei* new species

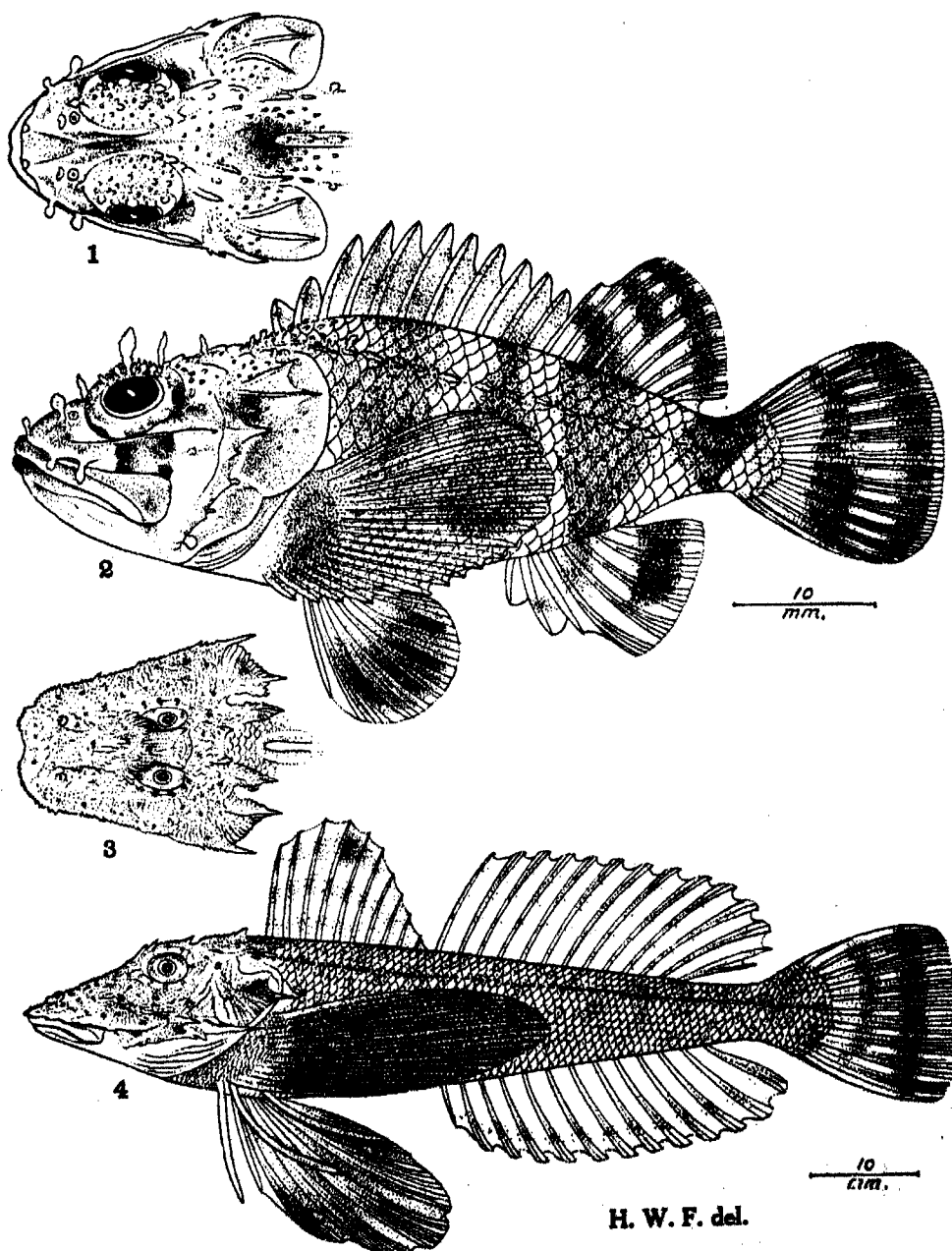
Figures 1 (head above) and 2.

Depth  $2\frac{2}{3}$ ; head  $2\frac{2}{3}$ , width  $1\frac{1}{3}$ . Snout measured to orbit  $4\frac{1}{3}$  in head; orbit  $3\frac{1}{3}$ ; eye  $3\frac{1}{3}$ ; maxillary reaches opposite hind orbital edge, expansion  $2\frac{1}{3}$  in orbit, length  $1\frac{2}{3}$  in head; mouth large, little inclined from horizontal, jaws equal; lips entire; teeth minute, finely villiform, in bands in jaws, on vomer and palatines; tongue small, free in front; bony interorbital narrowly concave, width  $3\frac{1}{3}$  in orbit; no quadrate pit at occiput. Gill opening large, extends well forward or opposite front pupil edge. Gill rakers 6+6, clavate, small, short,  $\frac{1}{3}$  of gill filaments which are  $\frac{1}{3}$  of eye.

Armature of head low, spines all with low keels. No nasal spines. Supraorbital edge low, entire; 2 low postero-supraorbital spines each side followed by long low parietal pair and a shorter occipital pair; postocular spine, followed by 2 keels to small suprascapular spine; 2 divergent opercular spines; long entire suborbital stay ends in small spine behind, then followed by largest of preopercular spines and below which are 4 broad marginal spines; preorbital with 3 low obtuse spines. Pectoral axil with small flap, with no exposed spine.

Scales 27+2 close along and above lateral line; tubes 18+2 in lateral line, each large and simple, course high along back, straight, inclined back to middle of caudal base; 4 scales above to second dorsal origin, 9 below to anal origin. Caudal base scaly, fins otherwise scaleless, also head, chest and breast. Three flaps along each preorbital, one above each front nostril, several on top of head, along preopercle edge and row of 5 prominent ones over each orbit with third longest, though less than eye, besides a number of quite smaller cirri. But few flaps along lateral line.

D. XI, 1, 8, 1, fifth spine 3 in head, second ray  $2\frac{2}{3}$ ; A. III, 5, 1, third spine  $3\frac{2}{3}$ , first ray  $2\frac{2}{3}$ ; least depth of caudal peduncle  $4\frac{1}{3}$ ; caudal  $1\frac{1}{2}$ , convex



H. W. F. del.

FIGS. 1 and 2.—*Scorpæna luckei* new species.FIGS. 3 and 4.—*Prionotus scitulus* Jordan and Gilbert.

behind; pectoral length from fin origin  $1\frac{1}{2}$ , rays 1, 6, XIII; ventral I, 5, fin length  $1\frac{1}{8}$  in head.

Color in alcohol light brown, inclining white on under surfaces, inclusive of immaculate pectoral axil. Orbit blackish above, iris silvery gray. Large blackish blotch below eye on cheek and several smaller ones on opercle. Body with large black blotch below front median part of first dorsal, below middle of second dorsal and third at caudal base, with last continued down over lower surface of tail. Dorsals brownish, with dark body blotches reflected on both fins basally. Second dorsal with broad dark brown border above, besides dark submarginal blotch anteriorly. Caudal pale or whitish, with 2 broad transverse blackish bands. Anal whitish, also with 2 blackish bands, first subbasal and anterior, and second submarginally posteriorly. Pectoral with broad dark brown suffusion basally and another subterminally, above and below paler to whitish. Ventral whitish, blackish brown terminally.

A.N.S.P. no. 69716. Tortugas, Florida, July 1937. Dr. Baldouin Lucké. Length 69 mm. Type.

I first suspected this may be *Scorpaena calcarata* Goode and Bean<sup>2</sup> based on a specimen 58 mm. long, U.S.N.M. no. 23566. I gratefully acknowledge the privilege of examining this specimen and others to the United States National Museum while recently in Washington. It differs at once in the slightly projecting lower jaw furnished with a symphyseal knob, the suborbital stay armed with 2 small spines, pair of preocular and pair of supraocular spines present, uppermost preopercular spine more than half as long as the eye which is nearly  $\frac{1}{3}$  as long as the head, supraocular flaps minute, cheeks with rather large imbricated scales, opercles with some scales anteriorly and on the opercular flap, breast scaly, ventrals reaching past vent, pectoral with rays all simple and axil of fin whitish with dusky specks, and a black spot at its upper edge. Its inclusion as a synonym of *Scorpaena inermis* Cuvier would therefore exclude that species, if this identification is correct.

*Scorpaena luckei* approaches *Scorpaena russula atlantica* Nichols and Breder<sup>3</sup> if the inference of the absence of an occipital quadrate pit is correct, though no reference is found in their description. It also differs greatly in coloration, absence of prepectoral scales besides no scales on the opercular flap, the absence of supraocular flaps, different anal spines and larger scales. Also approaches *Scorpaena isthmensis* Meek and Hildebrand,<sup>4</sup> but differs in its larger scales, scaleless head, prepectoral region and breast, and numerous flaps on the orbit above. It also differs in a similar

<sup>2</sup> Proc. U. S. Nat. Mus., vol. 5, 1882, p. 422 (type locality, Clear Water Harbor, Florida).

<sup>3</sup> Proc. Biol. Soc. Wash., vol. 37, 1924, p. 21, pl. 7 (type locality, off Galveston, Texas, 28° 56' N., 94° 48' W., in 10½ fathoms).

<sup>4</sup> Field Mus. Publ., no. 249, Zool. ser. vol. 15, pt. 3, 1928, p. 842, pl. 80 (type locality, Porto Bello, Panama).

way from *Scorpaena dispar* Longley and Hildebrand.<sup>5</sup> *Scorpaena isthmensis* by inclusion in "a" in "the key to the species" by Meek and Hildebrand, would have the "occipital pit large, well developed." I have examined the type of *Scorpaena dispar* in the United States National Museum and find the quadrate occipital pit well developed, the head well armed and scaly.

I have also examined the type of *Scorpaenodes floridae* Hildebrand<sup>6</sup> U.S.N.M., no. 108875, and find upon comparison with the figure that the latter is quite inaccurate. I find the head with large scales, only 2 rows on the postocular region between the hind edge of the eye and the upper limb of the preopercle, and only about 3 rows on the cheek. Moreover the keels with the spines on the head seem indicated as too low, as the scales do not crowd up on them, like those shown in the drawing. Dr. Hildebrand expressly calls attention to the "rather large blackish spot on the posterior part of the spinous dorsal", but the artist has not indicated it. Vernacular name—Lucke's Scorpion Fish.

(Named for Dr. Baldouin Lucké.)

### TRIGLIDAE

#### *Prionotus evolans* (Linnaeus)

One, 38 mm., off Boca Chica. Small spine basally at front of preopercular spine well developed though no spine at center of radiating striae on opercle. Pectoral fin 3 in fish without caudal. Color largely pale gray, back with 3 dark bars sloping forward.

One, 50 mm., off Shark River. Taken at night with a dip net by means of a lantern.

#### *Prionotus tribulus* (Cuvier)

One, 102 mm., Sanibel.

#### *Prionotus scitulus* Jordan and Gilbert

Figures 3 (head above) and 4.

Two, 80 to 88 mm., ten miles off Naples. As these differ greatly from my Boca Grande Specimens, not only in color but in structure as well, both with the bones of the head far more denticulate or finely serrate, I have given a figure of the larger.

### POMACENTRIDAE

#### *Pomacentrus leucostictus* Müller and Troschel

Three, 58 to 78 mm., Tortugas, with caudal and caudal peduncle bright yellow; two, 52 to 77 mm., Key West, November 1938 (Stewart Springer),

<sup>5</sup> Carnegie Inst. Wash. Publ., no. 517, 1940, p. 246, fig. 12 (type locality, south of Tortugas at a depth of about 40 fathoms).

<sup>6</sup> In Longley and Hildebrand, Carnegie Inst. Wash. Publ., no. 517, 1940, p. 251, fig. 14 (type locality, south of Tortugas in 45 fathoms).

with lower half of body, most of second dorsal posteriorly besides paired fins golden yellow, the blue spots distinct all over back, belly and front of anal.

### LABRIDAE

*Halichoeres radiatus* (Linnaeus)

Five, 66 to 79 mm., Tortugas; one, 140 mm., Sand Key; one, 118 mm. Key West, November 1938 (Stewart Springer).

*Xyrichtys rosipes* Jordan and Gilbert

One, 38 mm., Key West south; one, 57 mm., off Pacific Reef.

Color of smaller when fresh pale brown above, white below. Iris rose. Olive green bar from eye to front of jaws and a second bar from lower eye edge down on cheek; third one from postocular downward; fourth down on front of opercle; fifth from first dorsal spines to ventral origin; sixth from middle of first dorsal; seventh to ninth from second dorsal to anal and reflected on fins, between each projection olive blotch in interval on dorsal; tenth bar on caudal base. Front edge of dorsal pink. Pectoral pale. Ventral carmine and dark gray.

One, 34 mm., off Boynton, in 9 fathoms.

### SCARIDAE

*Sparisoma radians* (Valenciennes)

Two, 38 to 52 mm., off Boca Chica; two, 47 to 104 mm., off Pacific Reef.

*Sparisoma flavescens* (Schneider)

Five, 59 to 73 mm., Tortugas.

*Scarus croicensis* Bloch

One, 29 mm., Tortugas.

### CALLIONYMIDAE

*Callionymus boekei* Metzelaar

Depth 5; head, measured to gill opening,  $3\frac{1}{2}$ . D. IV—9, 1, A. 8, 1.

Color when fresh in alcohol with back gray to pearly. Along side of body from pectoral axil to caudal base row of 9 rather large pale yellow blotches, close set, and all just below axial line of body; all around them many small variable white spots. Pair of narrow black rings, less than eye, close behind eyes also close together at front part of interorbital. Iris carmine, gray-black above. Six dark olive bars along lower side of head transversely. First dorsal pale gray, with 5 dark mauve blotches on first spine and membrane; other membranes with dark spots, as dark blotch on last 2 broadly and terminally; third membrane terminally with many small whitish spots. Second dorsal and paired fins yellowish, ventrals brightest; tips of ventral rays white, with subterminal black blotch on each besides



another broader basally, upper surface of fin variegated with fine pearly dots and bars, with 2 broad pearly bars transversely on membrane up to upper part of pectoral basally. Pectoral pale yellowish, with 4 or 5 brown spots on each ray. Second dorsal pale, membranes each with 4 or 5 horizontal dark brown lines, more or less broken over rays. Anal pale, each membrane with 1 to 3 gray blotches, interspaces with variable whitish lines and bars. Caudal pale, with 3 transverse dark bands, on each ray formed more or less as dark spots, interspaces with pearly bars or spots.

One, 44 mm., off Pacific Reef.

Metzelaar's figures and descriptions are both crude, and no. 47 which is closest, certainly differs greatly in many details. Not only is the coloration entirely different, the lateral line is not indicated, the eyes are shown as greatly bulging upward and the spines of the preopercle too much inclined back.

***Callionymus floridæ* new species**

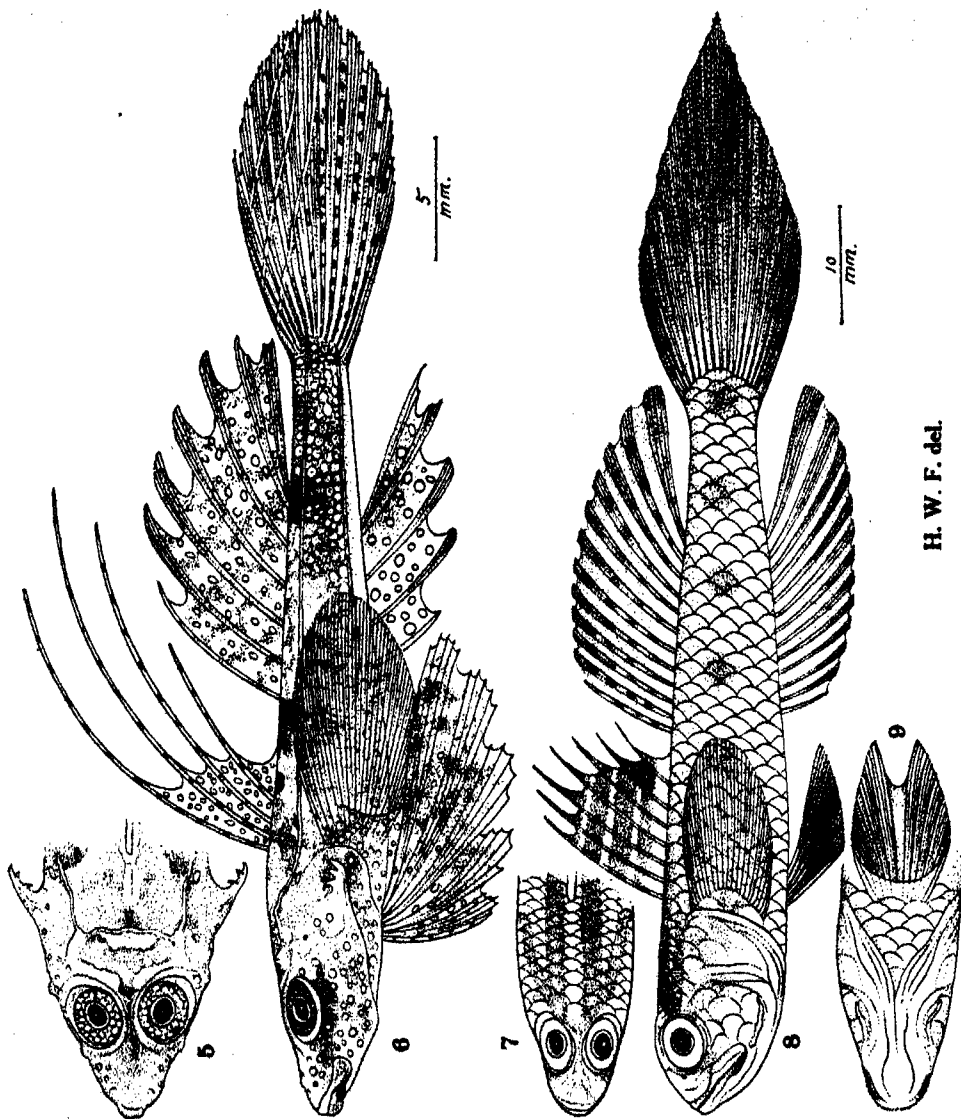
Figures 5 (head above) and 6.

Depth  $6\frac{2}{3}$ ; head measured to gill opening  $3\frac{1}{10}$ , width at bases of preopercular spines  $1\frac{1}{2}$  in head length. Snout measured to orbit  $3\frac{1}{2}$  in head as measured to gill opening; orbit  $3\frac{1}{2}$ ; eye  $4\frac{1}{2}$ ,  $1\frac{1}{2}$  in snout, greater than interorbital, not entering upper profile of head; edges of orbital bones entire; maxillary reaches  $\frac{3}{4}$  to orbit, length 4 in head measured to gill opening; mouth horizontal, jaws equal; teeth minute, uniform, fine, in narrow bands in jaws; bony interorbital  $3\frac{1}{2}$  in eye diameter, narrow ridge; no opercular flap. Preopercular spine long as eye, without prebasal spine, ends in upturned point and little directed back, besides 2 other erect upturned spines on upper edge. Gill opening small, superior.

Skin smooth, without papillae. Lateral line connected across occiput complete, superior along side of back, posteriorly not quite extending down to middle of caudal base. Along lower side of tail low longitudinal cutaneous keel, extends from above vent to lower part of caudal base.

D. IV—6, 1, all spines ending in filaments, second longest and reaches middle of last dorsal ray, fourth shortest or  $\frac{1}{2}$  of longest, third ray  $1\frac{1}{2}$  in head measured to gill opening; A. rays 4, 1, fin opposite second dorsal, fourth ray longest or  $1\frac{1}{2}$  in head; least depth of caudal peduncle 4; caudal  $2\frac{1}{2}$  in rest of fish, elongate, rounded; pectoral rays 24, fin equals head, rounded; ventral rays I, 5, much greater than pectoral or  $2\frac{1}{2}$  in fish without caudal, connected by basal membrane to upper  $\frac{2}{3}$  of pectoral base. Anal papilla  $\frac{1}{2}$  of eye.

Color in alcohol pale mauve to very pale gray-brown, with slight buff tinge on tail, and under surface white. Back with various blotches, marks or marbling of dark brown, darker than body color. Along back 4 dark brown blotches, contrasted, little irregular. Head above marbled with brown and 2 dark blotches along lower edge of cheek, besides darker bar along and below lower eye edge. Lower sides of head and connecting basal ventral membrane with pearly white spots. Lower edge of lower lip posteriorly with conspicuous black blotch. Along sides of body below, many light spots, their boundaries forming darker reticulations especially along

FIGS. 5 and 6.—*Callionymus floridæ* new species.FIGS. 7 to 9.—*Bollmannia jeannæ* new species.

side of tail above lower lateral cutaneous edge, along which are 6 black spots. Side of abdomen with scattered pearly spots. First dorsal transparent, spines with dark spots and membranes with small pearly spots. Second dorsal with 8 oblique dark lines and membranes all marked with scattered pearly spots. Anal transparent, with pearly spots. Caudal pale or whitish with 9 transverse dark bars. Pectoral white, with 10 short dark transverse lines or bars along and over upper rays. Ventral pale, marbled with dark gray-brown, sprinkled with pearly white spots.

A.N.S.P., no. 69717. Two miles off Boca Chica Key, Florida. April 14, 1940. In 1 to 5 fathoms. Length 42 mm. Type.

Possibly this may be found to be the same as *Callionymus calliurus* Eigenmann and Eigenmann,<sup>7</sup> though the original description differs in so many details that I am unable to identify it with my specimen. These are:

Head  $3\frac{1}{2}$  as measured from snout tip to hind tip of preopercular spine ( $3\frac{3}{10}$  in *C. floridæ*); lateral border of skin on tail wider than pupil (much narrower than *C. floridæ*); diameter of eye equals length of snout ( $\frac{1}{2}$  in snout of *C. floridæ*); last dorsal ray equals length of head measured to tip of preopercular spine ( $1\frac{1}{2}$  in *C. floridæ*); first dorsal spine reaches tip of last dorsal ray when depressed (only reaches to base of last dorsal ray in *C. floridæ*); a series of black dots on branchiostegal membranes (none in *C. floridæ*); 4 black spots on the lateral membrane of tail (9 black spots on lateral membrane of tail in *C. floridæ* and no other black spots above it); dorsal transparent, with white and dark dots most conspicuous between last rays (dorsal in *C. floridæ* with oblique dark lines and scattered pearly dots); membrane of anal sprinkled with minute black points aggregated into black spots in places (*C. floridæ* shows only dark shading besides the scattered pearly white spots). Vernacular name—Florida Dragonet.

A comparison with the description of *Callionymus dubiosus* Parr<sup>8</sup> and the figure by Miss Krause he publishes, shows a different species though apparently very closely related. Parr's specimen had 7 dorsal rays, with the last divided according to the figure; the longer dorsal spines all reaching beyond the caudal base; large orbit shown as well invading and breaking the upper profile line of the head; the small preopercular spine; the mandible greatly protruded down and apparently well exceeding the upper jaws; though the pectorals are said to be shorter than the ventrals, according to the figure they are about subequal; pectoral shown as reaching over half way to caudal base; the coloration described, and indicated on the figure, different from my specimen, especially the presence of black dots and spots, and no mention of the very numerous and conspicuous white dots and spots.

<sup>7</sup> Proc. Cal. Acad. Sci., ser. 2, vol. 1, 1888, p. 76 (type locality, off South Beach, Key West, in 5 fathoms).

<sup>8</sup> Bull. Bingham Oceanogr. Coll., vol. 3, art. 4, 1930, p. 130, fig. 36 (type locality, Cat Island, Bahamas).

## GOBIIDAE

*Bollmannia jeannae* new species

Figures 7 (head above), 8 (lateral view), and 9 (head below).

Depth  $5\frac{1}{2}$  to  $5\frac{3}{4}$ ; head  $3\frac{1}{2}$  to  $3\frac{3}{4}$ , width  $1\frac{1}{2}$  to  $1\frac{3}{4}$ . Snout  $4\frac{1}{2}$  to  $5\frac{1}{2}$  in head measured from its own tip, which level with lower eye edge or lower pupil edge; eye 3 to  $3\frac{1}{4}$ , greater than snout or very narrow interorbital, not entering upper profile of head; maxillary extends  $\frac{1}{2}$  in eye, length 2 to  $2\frac{1}{2}$  in head measured from snout tip; mouth well inclined, mandible well protruded in front; teeth simple, pointed, conic, little curved, in narrow or biserial band in front of each jaw, narrowing and smaller posteriorly in jaws; no teeth on palate; tongue large, free in front, broad, with deep notch on anterior edge; interorbital bony width very narrow frenum. Gill opening lateral, rather restricted or not extended forward of vertical preopercle limb. Gill rakers 5+8, lanceolate, long as gill filaments or  $\frac{1}{4}$  of eye.

Scales large, many fallen, 25 or 26+2 in axial lateral series; 8 transversely between second dorsal and anal origins; predorsal 9 or 10, with anterior scales much larger. Head largely scaled, with 3 series of larger scales on cheek, also opercle, prepectoral region, chest and breast scaled. Scales little larger posteriorly on tail, and caudal base scaly only fin apparently scaly.

D. VII—I, 11, 1, spines terminally flexible, with third  $1\frac{1}{4}$  to  $1\frac{1}{2}$  in total head length, first ray  $1\frac{1}{4}$  to 2, last ray  $1\frac{1}{4}$ ; A. I, 12, 1, first ray 3 to 4, last ray  $1\frac{1}{4}$  to  $1\frac{1}{2}$ ; least depth of caudal peduncle  $3\frac{1}{4}$  to  $3\frac{3}{4}$ ; caudal  $1\frac{1}{4}$  to  $1\frac{1}{2}$  in rest of fish, ends in long median point behind; pectoral 1 to  $1\frac{1}{6}$  in total head length, rays 23; ventral rays I, 5, fins united, with broad anterior basal frenum, fin  $1\frac{1}{2}$  in total head length.

Color in alcohol rather uniform light gray-brown, paler to whitish on under surfaces. Dark grayish on each side of lower lip toward rictus. Iris silvery white. White horizontal line on lower part of cheek. From upper hind eye edge brownish band, rather ill-defined, forked with main branch back each side to front of first dorsal, lower section follows along upper part of opercle. On side of body row of 5 brown blotches medially, last most distinct at caudal base. Fins largely pale or uniform brownish. First dorsal with 4 brown parallel horizontal bands, lowest as black blotch on sixth membrane. Each ray of second dorsal with 4 brown spots. Edges of caudal above and below with a few brown spots.

A.N.S.P., no. 69718. Off Key West south, Florida. In 19 fathoms. April 12, 1940. Length 93 mm. Type. Mrs. Frank R. Schwengel.

A.N.S.P., no. 69719, same data. Length 80 mm. Paratype.

Apparently most closely related to *Bollmannia boqueronensis* Evermann and Marsh,<sup>9</sup> but differs in larger scales on the cheek, shorter pectoral and the coloration. *Bollmania litura* Ginsburg<sup>10</sup> is also quite different, with

<sup>9</sup> Bull. U. S. Fish Comm., vol. 20, pt. 1, 1902, p. 298, fig. 92 (type locality, off Puerto Real, Porto Rico, in 8.5 fathoms).

<sup>10</sup> Smithsonian. Miscell. Coll., vol. 91, no. 20, 1935, p. 1, pl. 1 (type locality, Samana Bay, Dominican Republic, in 18 to 19 fathoms).

much shorter body, larger paired fins and different coloration. Vernacular name—Jeanne's Goby.

(For Mrs. Frank R. Schwengel.)

**Gobionellus stigmaticus** (Poey)

Color when fresh in alcohol pale buff-brown above generally, below white, former all variegated with white blotches or spots, variable and ill-defined. Iris pearl-gray. Blackish brown line down from iris to behind end of maxillary, which is opposite hind eye edge. Black blotch on middle of opercle. Five short black bars, horizontal and axial with last at caudal base. Dorsal pale yellowish, first with 7 narrow well-defined horizontal bands; soft dorsal similar. Anal grayish. Caudal pale buff-yellow above, lower half gray, darkest marginally. Pectoral whitish, brownish over greatest terminal part and dotted profusely with dark brown. Ventral white, innermost 2 rays gray-black.

One, 42 mm., American Shoal.

**Garmannia macrodon** (Beebe and Tee Van)

Two, 26 to 28 mm., Sanibel.

**Gobiosoma robustum** Ginsburg

Two, 35 mm., Sanibel.

**BLENNIIDAE**

**Enneapterygius pectoralis** new species

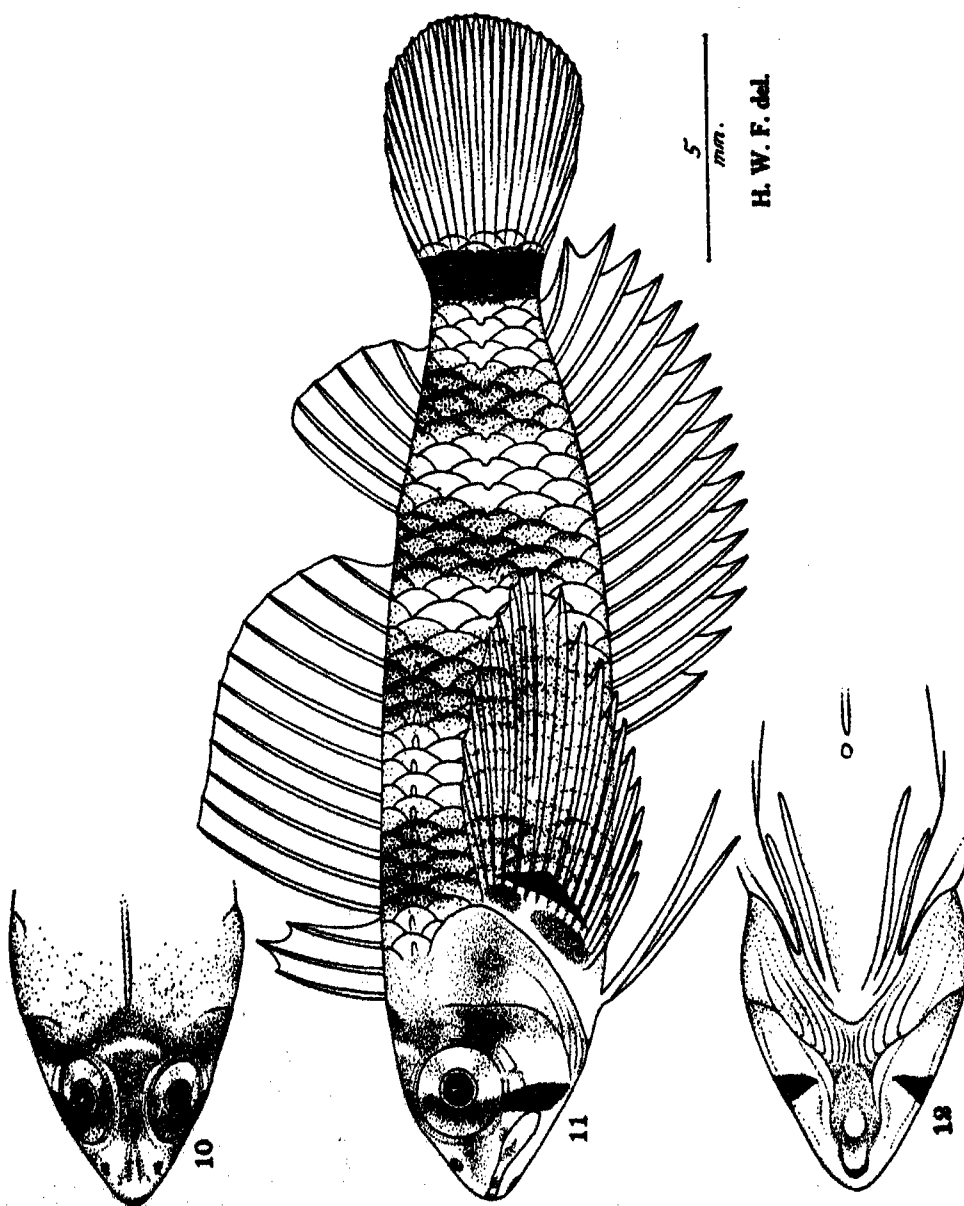
Figures 10 (head above), 11 (lateral view) and 12 (under view of head.)

Depth  $4\frac{1}{2}$ ; head  $3\frac{1}{2}$ , width  $1\frac{1}{2}$ . Snout  $4\frac{1}{2}$  in head, its tip level with lower edge of eye; eye 3, greatly exceeds snout or interorbital, not impinging on upper profile of head; mouth moderate, jaws even in front; maxillary little inclined from horizontal, reaches  $\frac{2}{3}$  in eye or opposite front pupil edge, length 3 in head; teeth small, simple, conic, in narrow bands in jaws; bony interorbital narrow, less than half of eye. Gill opening large, extends forwards nearly opposite hind eye edge.

Head apparently entirely naked, also chest, breast and prepectoral region. Trunk and tail covered with large scales, cycloid and regularly disposed. Lateral line scales  $13+15+2$ , first or upper section high and with large tubes.

D. III, XI—6, second spine  $2\frac{1}{2}$  in head, first spine of second spinous fin  $1\frac{1}{2}$ , first ray  $2\frac{1}{2}$ ; A. XVII, first spine  $2\frac{1}{2}$ , seventh spine  $1\frac{1}{2}$ ; caudal  $1\frac{1}{2}$ , convex behind; least depth of caudal peduncle  $2\frac{1}{2}$ ; pectoral 1, 4, x, fin reaches  $1\frac{1}{2}$  to caudal base, longer than head; ventral 2, fin  $1\frac{1}{2}$  in head.

Color in alcohol pale to gray-white. Dark shade involves interorbital, reflected on front half of eye and continued down as blackish bar on cheek behind maxillary. On predorsal dark band arches back to first dorsal origin and down each side to eye. Also dark gray diffuse shade back on opercle. On body 4 broad dark gray bands, first and second from below second spinous dorsal, third at interval between second and third dorsals and fourth from hind part of third dorsal. In each of foregoing dark bands scale



FIGS. 10 to 12.—*Enneapterygius pectoralis* new species.

edges gray-black. Transverse black band at caudal base, narrower than any of dark bands on body. At pectoral base 2 dark gray blotches, lower larger, also black broadly triangular partly basal bar. At under symphyseal margin of mandible narrow black marginal arc. Maxillary with several grayish blotches.

A.N.S.P. no. 69728. Off Sanibel Island, Florida, in 10 fathoms. April 21, 1940. Length 23 mm. Mrs. Frank R. Schwengel. Type.

An interesting species known by its greatly elongated or enlarged pectoral fins. It differs from *Enneapterygius carminalis* (Jordan and Gilbert) from Mazatlan and *Enneapterygius jordani* (Evermann and Marsh) from Porto Rico, in details of coloration as well as proportions and other structural characters. Due to comparatively poor preservation of the type I have been unable to locate any scales on the opercle. Vernacular name—Long-finned Blenny.

(*Pectoralis* with reference to the long pectoral fins.)

**Brannerella ocellata** (Steindachner)

One, 47 mm., Sanibel. Scales 35 in lateral line.

*Brannerella shuiteri* Metzelaar was described without comment as to its relationship with other species. Evidently it appears to be the present species. The alternating dark blotches shown in the figure could very well have been emphasized by the action of preservative and they are in agreement in their disposition, crude as the figure seems. I fail to find any characters from the published accounts which would establish that nominal species. The "two black spots at posterior part of anal base" are not shown on Metzelaar's figure.

**Malacoctenus macropus** (Poey)

Depth 4; head 3, width  $1\frac{1}{2}$ . Snout 3 in head; eye  $3\frac{1}{2}$ , subequal with snout. Scales  $34+7$  (last 7 tubeless) in lateral line; 3 above at first dorsal origin, 5 below from front of straight section to base of anal. D. XXII, 10; A. 24.

Color in alcohol brownish, paler to whitish below, with 6 darker brown transverse bands, well-separated with as many little paler ones in intervals. Brown bar before eye and another obliquely to occipital filament from hind eye edge. Five brown lines across lower side of head, last 3 more or less broken as spots. Iris gray. Opercle mottled with brown. Fins all pale. Dorsals with dark bands of body reflected on their basal parts, with brownish blotches up to their submarginal area and edge of fin pale. Second dorsal with paler and more numerous transverse lines. Anal, caudal and pectoral largely uniform, first with submargin of fin gray and tip of each ray whitish. Ventral white.

One, 34 mm., Tortugas.

***Paraclinus marmoratus* (Steindachner)**

One, 53 mm., Cocoanut Grove, Biscayne Bay, Jan. 23, 1939 (Samuel Bell 3rd); one, 68 mm., Key West, 1940. Both dark to blackish brown, with pale and white caudal.

Two, 46 to 48 mm., off Miami Beach. Pale brown flushed deeply with rose, especially dorsal and anal, back and iris. Two blue-black-edged ocelli on dorsal and 1 on anal conspicuous and contrasted. Each scale on body usually with a pearly spot.

Two, 34 to 38 mm., between Johnson Key and Key West.

***Paraclinus fasciatus* (Steindachner)**

One, 43 mm., Biscayne Bay (Dr. H. A. Pilsbry); four, 28 to 38 mm., off Boca Chica.

***Paraclinus supracorniculum* new species**

Figure 13.

Depth  $3\frac{1}{2}$ ; head  $3\frac{1}{10}$ , width  $1\frac{1}{2}$ . Snout  $5\frac{1}{2}$  in head measured from its own tip, which level with lower part of eye; eye  $4\frac{1}{10}$  in head measured from snout tip, greater than snout or narrow interorbital, not entering upper profile of head; long simple supraorbital tentacle bifid at tip, equals combined eye and snout; maxillary well inclined, extends behind eye, length  $1\frac{8}{10}$  in head measured from snout tip; lips smooth, entire; mouth large, lower jaw well protruded in front; small patch of villiform teeth, simple, uniform at each side of front of upper jaw, followed by row of teeth on each premaxillary with posterior little larger; lower jaw teeth similar; small narrow triangular band of fine teeth on vomer; interorbital  $1\frac{1}{2}$  in eye, narrowly convex; opercle with strong spine high and directed back. Gill opening extends forward opposite first fourth in postocular space, gill membranes forming broad fold across isthmus. Gill rakers  $2+8$ , lanceolate, little shorter than gill filaments, which  $\frac{1}{2}$  of eye.

Scales large, more or less uniform, only little smaller on caudal base. Lateral line  $12+15+2$ , high at first over pectoral, then median along side of tail; tubes in lateral line  $12+18$ , in lower section mostly alternately skipping scales; 4 scales above lateral line from front of straight section, 4 below to anal origin. Chest and breast scaled. Head scaleless.

D. XXVII, 1, edge notched on each membrane, tenth spine  $2\frac{1}{2}$  in total head length, last spine  $2\frac{1}{2}$ ; A. II, 18, first ray  $4\frac{1}{2}$ , seventeenth ray  $2\frac{1}{10}$ , fin edge deeply notched along its entire extent; last dorsal and anal rays joined to caudal base by membrane; caudal  $1\frac{1}{10}$ , convex behind; pectoral  $1\frac{2}{3}$ , rays 12, depressed fin reaching anal origin; ventral with 2 rays, length  $1\frac{1}{2}$  in total head length.

Color in alcohol very pale or light brown, scarcely paler below. Body without any darker markings. Iris carmine, with gray-brown reticulations. Long supraorbital cirrus carmine. From each upper hind eye edge rose-pink band back to middle of occiput, where meeting its fellow from opposite eye and forms a definite rose colored Y. On trunk most of scales with variable pearly spots or blotches. On cheek irregular pearly pink band from lower hind eye edge down towards ventral origin. Pair of similarly inclined pearly bars on pectoral. Dorsal and anal with pinkish tinge, otherwise fins appear to be colorless.



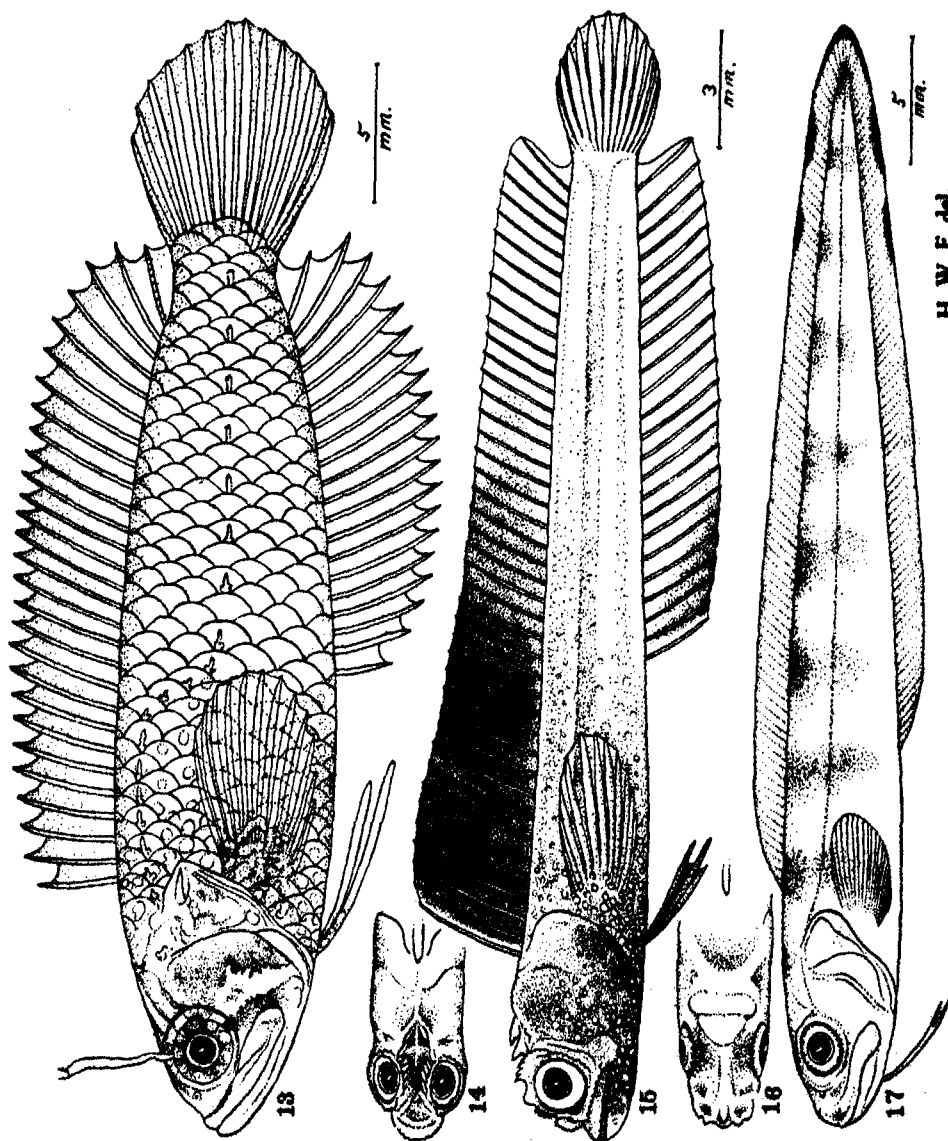


FIG. 13.—*Parachinus supracorniculum* new species.

FIGS. 14 and 15.—*Paramblemaria erythroptera* new species.

FIGS. 16 and 17.—*Lepophidium jeannae* new species.

A.N.S.P., no. 69720. From off Pacific Reef, Florida. In 45 to 50 fathoms. April 21, 1940. Length 38 mm. Type. Mrs. Frank R. Schwengel.

Related to the two preceding species of this genus, differing greatly in coloration, details in proportion and especially in the long supraorbital tentacle. It also approaches *Paraclinus affinis* (Steindachner), though that species also differently colored, with more dorsal spines and small scales. Vernacular name—Horned Blenny.

(*Supra* above + *corniculum* little horn or tentacle, with reference to the eye.)

**Hypsoblennius ionthas** (Jordan and Gilbert)

One, 49 mm., Sanibel. Supraocular filament simple.

**Parembelmaria erythrops** new species

Figures 14 (head above) and 15.

Depth  $6\frac{1}{2}$  to  $7\frac{1}{2}$ ; head  $3\frac{1}{2}$  to  $4\frac{1}{2}$ , width  $2\frac{1}{2}$  to  $2\frac{3}{4}$ . Snout in profile 6 in head; eye  $4\frac{1}{2}$ , high, largely directed forward and upward, greater than snout length as seen in profile; mouth horizontal, with strong equal jaws, ensheathed behind by broadly rounded projection of lower postorbital; teeth large, apparently not covered by lips, firm, erect, close-set, with 10 in front transversely and 6 similarly below, others on sides of both jaws numerous and diminishing well posteriorly; orbital ridge more or less well spinigerous, with at least serrated edge of 5 supraorbital spines directed forward; 2 pairs of postorbital spines on top of head, each well directed forward and converging so posterior spines meet behind, though extend only on first half of predorsal space as measured forward to eyes; interorbital less than eye in width or 7 in head, deeply concave; opercle unarmed. Gill opening with broad free gill membranes over isthmus, extends forward  $\frac{1}{2}$  in postocular space.

Skin smooth, scaleless. Lateral line not evident.

D. 40, continuous, anteriorly flexible with second ray longest or  $1\frac{1}{2}$  in head, rays little distinguishable as spines and rays, fin height at last third of fish 3 in head; A. 23, fin height medially  $2\frac{1}{2}$ , fin edge largely entire; caudal peduncle defined, least depth  $3\frac{1}{2}$  in head; caudal  $1\frac{3}{4}$ , rounded; pectoral  $1\frac{3}{4}$ , rays 12; ventral rays 3, fin  $1\frac{1}{4}$  in head or reaches  $1\frac{1}{4}$  to anal.

Color in alcohol with head pale to whitish above with pinkish tint. Iris carmine. Lower part of head, thorax and trunk below all lined or dark to blackish brown, branchiostegal region and membranes especially dark to blackish. All this dark region sprinkled with pearly or blue-white spots. Similar scattered spots all over trunk and tail, variable, though indistinct posteriorly. Fins all more or less brown, dorsal with pale front margin along first ray, then blackish back to middle of fin. Anal with only small extent dark to blackish anteriorly, or only on first 5 or 6 membranes terminally. Pectoral dark brown basally, terminally paler. Ventrals blackish.

A.N.S.P., no. 69721. Off Miami Beach, Florida, in  $8\frac{1}{2}$  fathoms. April 22, 1940. Length 29 mm. Type. Mrs. Frank R. Schwengel.

A.N.S.P., no. 69722, same data, paratype. Length 24 mm. This specimen without black, though with similar frontal armature of smaller spines and armature.

A.N.S.P., no. 69723. American Shoal, Florida. In  $5\frac{1}{2}$  fathoms. April 16, 1940. Length 22 mm. Paratype. Also a head, 8 mm. long, from off Miami Beach, same data as type.

Several species appear to be involved in the comparison with the present. *Acanthemblemaria spinosa* Metzelaar<sup>11</sup> has entirely different armature of head as the figure shows the spines on top of the head extending nearly back to the origin of the dorsal; ventral long as eye; dorsal with 2 simple rays and 30 branched rays; anal with 3 simple and 22 branched rays; though the spines are said to be "very strong on supraorbital ridge" simply a keel appears to be shown in profile on the drawing.

*Acanthemblemaria variegata* Beebe and Tee Van<sup>12</sup> approaches the preceding in its spinescent head and short ventrals. It differs in the presence of a short simple supraorbital cirrus, uniformly low spineless dorsal of 21 spines lower than second dorsal, besides the coloration.

It follows that the two above compared fishes may hardly even be congeneric, aside from *Acanthemblemaria arborescens* Beebe and Tee Van,<sup>13</sup> with its large branched supraocular and nasal tentacles, also with extensive spines on nearly the entire predorsal region. Longley had previously ascertained this distinction by proposing *Parembelmaria aspera*.<sup>14</sup> Recently Longley and Hildebrand<sup>15</sup> have merged *Acanthemblemaria arborescens* Beebe and Tee Van with *Parembelmaria arborescens* and suppress the genus *Parembelmaria*. I cannot accept this conclusion and thus feel the distinctions are additionally amplified by the present species. This seems to differ strikingly from *Parembelmaria aspera* Longley in the heavier frontal armature which is less extensive or more confined anteriorly on the head, the higher and less advanced dorsal, longer ventrals, shorter pectorals and especially in the absence of the nasal and supraorbital branched tentacles. The large bony extension posteriorly and downward of the suborbitals is not indicated on Longley and Hildebrand's figure, nor on that of *Acanthemblemaria arborescens* Beebe and Tee Van. Vernacular name—Red-eyed Blenny.

(*ῥυθρὸς* carmine + *ὤψ* eye.)

<sup>11</sup> Rapp. Kolonie Curaçao, vol. 2, pt. 1, 1919, p. 159, fig. 53 (type locality, Curaçao).

<sup>12</sup> Zoologica, N. Y. Zool. Soc., vol. 10, no. 1, 1928, p. 247, fig. (type locality, Lamentin Reef, Port-au-Prince Bay, Haiti).

<sup>13</sup> Op. cit., p. 244, fig. (type locality, Lamentin Reefs, Port-au-Prince Bay, Haiti).

<sup>14</sup> Carnegie Inst. Wash. Year Book, no. 26, 1927, p. 244 (type locality, Tortugas, Florida).

<sup>15</sup> Carnegie Inst. Wash. Publ., no. 517, 1940, p. 271.

## OPHIDIIDAE

*Lepophidium jeannae* new species

Figures 16 (head above) and 17.

Depth  $8\frac{1}{2}$ ; head  $4\frac{2}{10}$ , width  $2\frac{1}{2}$ . Snout 4 in head; eye 4, equals snout or interorbital, not entering upper profile of head; maxillary extends posteriorly opposite hind eye edge, length 2 in head; mouth large, horizontal, lower jaw shorter and little included; lips entire, smooth; teeth simple, conic, slender, pointed, of moderate size with irregular smaller ones and uniserial in jaws; band of fine teeth across vomer and narrow one on each palatine; end of snout above with concealed median spine, directed forward and little downward; interorbital broad, low, but slightly convex. Gill opening large, extends forward opposite middle of eye. Gill rakers  $3+8?$ , short points, little less than gill filaments which not quite long as pupil diameter.

Scales feeble and very small, only imperfectly indicated on back and tail. No indication of lateral line.

Dorsal, anal and caudal confluent. Dorsal begins slightly behind head and pectoral origin, rays  $88?$ , greatest fin height  $5\frac{1}{2}$  in head; A.  $70?$ , fin origin slightly behind first third in total length, fin height  $5\frac{1}{2}$  in head; caudal 4, short; pectoral  $2\frac{1}{2}$ , rays 17; ventral filament inserted slightly before front eye edge, length 2 in head.

Color in alcohol very pale or dilute brown, inclining to whitish on under surface of head and body. Iris pearly or silvery white, with dark gray chromatophores about outer edge. Ventrals whitish, fins otherwise pale to whitish. On side of body 10 brownish ill-defined equidistant and rather large brownish spots or blotches, first at occiput and others all along base of dorsal fin. These blotches with median axial reflections for whole extent of body. Edge of caudal on end of tail narrowly blackish, with 2 black margins anteriorly both on dorsal and anal, and opposite second and third from last blotch along back.

A.N.S.P., no. 69724. Main Channel south of Key West, Florida. In 19 fathoms. April 10, 1940. Length 45 mm. Type. Mrs. Frank R. Schwengel.

Apparently to be distinguished by its proportions and coloration. *Lepophidium brevibarbe* (Cuvier) is noticed by the Beebe and Tee Van<sup>16</sup> with the short ventral  $2\frac{1}{2}$  in the head, scaly head and dorsal and anal with a black margin, their specimen 209 mm. long. As *Ophidium brevibarbe* Kaup<sup>17</sup> is with a figure of the head it is shown scaly behind the eye, eye 4 in head and little longer than snout, ventral fin  $3\frac{1}{2}$  in head and the specimen 7.88 inches. Vernacular name—Jeanne's Cusk Eel.

(For Mrs. Schwengel.)

<sup>16</sup> Zoologica, N. Y. Zool. Soc., vol. 10, no. 1, 1928, p. 251, fig. (Port-au-Prince, Haiti).

<sup>17</sup> Cat. Apodal Fish Brit. Mus., 1856, p. 154, pl. 16, fig. 1 (Brazile).

## DACTYLOSCOPIDAE

*Dactyloscopus tridigitatus* Gill

*Dactyloscopus tridigitatus* Gill, Proc. Acad. Nat. Sci. Phila., 1859, p. 132 (type locality, Barbadoes); 1861, p. 117 (types), p. 264 (types; Garden Key, Fla.; Cuba).—Evermann and Kendall, Rep. U. S. Fish Comm., pt. 25, 1900, p. 92 (Key West, Pensacola, Cape Florida).—Starks, Stanford Univ. Publ., 1913, p. 71 (Natal, Brazil).—Metzelaar, Rapp. Kolonie Curaçao, vol. 2, pt. 1, 1919, p. 148 (Wacao, Curaçao).—Fowler, Proc. Acad. Nat. Sci. Phila., vol. 80, 1928, p. 467 (Porto Rico).

*Dactyloscopus poeyi* Gill, op. cit., 1861, p. 266 (type locality, Cuba).—Metzelaar, op. cit., fig. 45 (Windward Islands).

*Congrammus moorei* Fowler, op. cit., 1906, p. 105, fig. 13 (type locality, Hailer's Rock, Florida).

*Dactyloscopus crossotus* Starks, op. cit., p. 70, pl. 12 (type locality, Natal, Brazil).

Two, 47 to 58 mm., between Naples and Marco 10 miles off shore; three, 45 to 78 mm., off Key West south; two, 39 to 57 mm., off Boynton; head 11 mm. long, off Sanibel, in 10 fathoms, April 21.

Color when fresh in alcohol very pale translucent whitish, some even with a pinkish tint, besides a pearly luster on head and back. Twelve pure white blotches along edge of back at dorsal base, in large specimen increased to 21; all show more or less large irregular white blotch on occiput, besides several white blotches in front and behind, and as seen along upper side of head form 4 or 5 irregular white spots. Cheek, preopercle and opercle largely pearly white. Iris gray. Jaws and maxillary white. All over back each scale with dark basal blotch due to pigment of each scale pocket in smaller specimens forming 3 longitudinal series with median axial. Dark spot large as eye at middle of caudal base, fins otherwise whitish.

A paratype of the species, no. 6307 U.S.N.M., 67 mm. long, was kindly loaned by the United States National Museum, also no. 6310 from Florida, and both agree in having the lips entire. In the original description of the species cited above no mention is made of fringed lips, like those of *Congrammus moorei* and *Dactyloscopus crossotus*. In Gill's next account his Barbados and Florida specimens are not mentioned explicitly, and others which subsequently form the types of *Dactyloscopus poeyi* and *Dactyloscopus pectoralis* are placed in the family Uranoscopidae, which is said to have the lips fringed. In the same paper a little farther on, or after the generic diagnosis Gill says "it may not be deemed necessary to add that the family characters above given apply entirely to this genus . . . and that the lips are fringed as in the other members of the family." There is very little in the description of *D. crossotus* Starks, or its figure, to maintain its distinction.

## URANOSCOPIDAE

*Astroscopus y-graecum* (Cuvier)

One, 57 mm., off Boca Chica.

**BROTULIDAE*****Ogilbia cayorum* Evermann and Kendall**

*Ogilbia cayorum* Evermann and Kendall, Bull. U.S. Fish Comm., vol. 17, 1897 (1898), p. 132, pl. 9, fig. 14 (type locality, Key West, Florida).—Jordan and Evermann, Bull. U. S. Nat. Mus., no. 47, pt. 3, 1898, p. 2503 (type); pt. 4, 1900, pl. 355, fig. 873 (type).—Jordan and Thompson, Bull. Bur. Fisher. U. S., vol. 24, 1904 (1905), p. 255 (Tortugas).—Fowler, Proc. Acad. Nat. Sci. Phila., 1906, p. 108 (West Cudjoe's Key, Fla.).—Parr, Bull. Bingham Oceanogr. Coll., vol. 3, art. 4, 1930, p. 133 (Bahamas).

Fifteen, 17 to 46 mm., Tortugas.

**BATRACHOIDIDAE*****Opsanus beta* (Goode and Bean)**

Four, 89 to 175 mm., Sanibel, "gray and yellow"; one, 195 mm., Sand Key; one, 81 mm., off Boca Chica; two, 50 to 59 mm., American Shoal.

**MONACANTHIDAE*****Monacanthus ciliatus* (Mitchill)**

Fifteen, 47 to 70 mm., Tortugas; two, 76 to 112 mm., off Boca Chica; two, 93 mm., in from American Shoal; five, 60 to 80 mm., off Miami Beach; eight, 52 to 74 mm., between Johnson and Key West. Color grass green.

***Stephanolepis hispidus* (Linnaeus)**

Three, 25 to 42 mm., Tortugas; one, 44 mm., off Boca Chica; one, 20 mm., American Shoal.

**OSTRACIIDAE*****Lactophrys triqueter* (Linnaeus)**

Six, 17 to 45 mm., Tortugas.

***Lactophrys tricornis* (Linnaeus)**

One, 180 mm., Sanibel; one, 88 mm., off Little Shark River. Body marked with large pearl-blue spots above and on sides, under surfaces immaculate.

**TETRODONTIDAE*****Sphoeroides spengleri* (Bloch)**

Eight, 47 to 65 mm., Tortugas; one, 57 mm., off Johnson Key, with predorsal and entire upper surface smooth; back more or less yellowish or gamboge olive, mottled with dark gray; like Todd's figure of *Sphoeroides nephelus* Goode and Bean, the eye there shown as smaller and the predorsal region spinescent; one, 38 mm., off Boca Chica, its predorsal spinescent.

**Sphoeroides testudineus** (Linnaeus)

One, 13 mm., off Boynton, in 9 fathoms. Eye less than broad interorbital.

**CANTHIGASTERIDAE**

**Canthigaster rostratus** (Bloch)

One, 28 mm., off Boynton.

**DIODONTIDAE**

**Diodon hystrix** Linnaeus

One, 135 mm., to end of broken caudal, Sanibel.

**Cyclichthys schoepfi** (Walbaum)

One, 140 mm., Sanibel.

**ANTENNARIDAE**

**Antennarius scaber** (Cuvier)

One, 87 mm., South Inlet, Lake Worth, 1940 (Dr. H. A. Pilsbry).

**Antennarius radiosus** Garman

One, 33 mm., off Palm Beach in 400 to 500 fathoms, July 19, 1940 collected by Tom McGinty (R. A. McLean).

Although differing in proportion the "bait" as depressed not reaching beyond the end of the second dorsal spine, the lateral line not falling so low on the caudal peduncle and the paired fins longer, the color uniformly dark or blackish, it appears in other ways to agree. The large black blotch median on dorsal basally though indistinct and not ocellated is unmistakable. In one point the "bait" ends in a single cutaneous flap, and is apparently intended so in Garman's figure, though his description says it "bears a small trifold bait." Longley has identified *Antennarius astroscopus* Nichols, which I have recorded from Boca Grande, as an uncertain synonym of *Chironectes multiocellatus* Valenciennes, besides including as other synonyms *Antennarius verrucosus* Bean and *Antennarius corallinus* Poey.

**ONCOCEPHALIDAE**

**Oncocephalus radiatus** (Mitchill)

One, 124 mm., Sanibel.

**MESOPLODON MIRUS IN NEW JERSEY, WITH ADDITIONAL NOTES ON  
THE NEW JERSEY M. DENSIROSTRIS, AND A LIST AND KEY  
TO THE ZIPHOID WHALES OF THE ATLANTIC  
COAST OF NORTH AMERICA**

BY FREDERICK A. ULMER, JR.

*Department of Mammals, The Academy of Natural Sciences of Philadelphia*

On January 9, 1940, a female True's beaked whale (*Mesoplodon mirus*) washed ashore on Island Beach below Seaside Park in Ocean County, New Jersey. It stranded about four miles below Seaside Park on the Phipps Estate, a private property which embraces the entire southern portion of the island. Mr. Joseph Tilton, ex-keeper of the Forked River Coast Guard Station, first discovered the whale while patrolling the beach. At that time he removed the right flipper for a souvenir.

I did not learn about the stranding until late in February when a "little whale with a beak" was described to me by members of the Delaware Valley Ornithological Club. They were Mr. and Mrs. Quentin Kramer, Mr. Millard Lindauer and Mr. Robert Newman, who made frequent trips to Island Beach during the winter to observe winter sea birds.

On February 28, my brother, Mr. John Leeds Ulmer, and I reached Island Beach where we found the whale half buried in the sand, well above the high tide mark. Having lain on the beach for almost two months, the whale was somewhat decomposed. We had the very cold weather of January and February to thank for the fact that it was not in a far more advanced state of decay. After taking many photographs, notes and careful measurements of the animal, we set about the task of fleshing out the skeleton.

I am very grateful to Mayor Francis P. Freeman of the Borough of Island Beach, who supplied pictures and valuable information concerning the whale and who was instrumental in securing the missing right flipper. Upon learning that I wanted the missing flipper, Mr. Tilton very kindly presented it to the Academy. The skeleton, including the pelvic bones, is now no. 20484 in the mammal collection of the Academy of Natural Sciences of Philadelphia. This is the first record of this species of beaked whale for the New Jersey coast.

I wish to thank Dr. Glover M. Allen, of the Museum of Comparative Zoölogy at Cambridge, Mass., Dr. H. C. Raven, of the American Museum of Natural History in New York, Dr. Remington Kellogg, of the United



States National Museum in Washington, and Mr. Charles H. Blake, of the New England Museum of Natural History in Boston, for the assistance they have given me in the preparation of this paper.

### *External Features*

*Color*.—Upper parts glossy black, becoming dull black on the under parts. The color of the skin of whales changes very rapidly after death and since this specimen had been lying on the beach so long, color notes are of little importance. By the action of sand and water much epidermis had been rubbed off, leaving large white patches on the sides of the animal.

*Form*.—Slender, when viewed dorsally; body decidedly compressed laterally. When viewed from the side the body was very deep. Dorsal fin small, roughly triangular and placed well behind the middle of the body. From the dorsal fin to the tail flukes, the body was very compressed laterally. A distinct dorsal ridge stretched from the back of the dorsal fin to between the flukes. There was no indication of a neck constriction. The mandible projected slightly farther than the rostrum.

When I examined them, the flippers agreed with Raven's description (1937, p. 17) of the flippers of the Long Island specimen, even to fitting snugly against the body in slight depressions. However, they stand well out from the body and appear rather pointed in a picture taken by Mayor Freeman early in January when the animal was in a fresh condition. In this picture there is no sign of depressions for the flippers, so that this condition is evidently a post-mortem one as Dr. Raven suggested.

TABLE I.—External Measurements of *M. mirus*

Adult ♀ A.N.S.P. no. 20484

Total length (between uprights) .....	16' = 4870 mm.
Tip of rostrum to rostral border of dorsal fin .....	9' 4" = 2844 mm.
Length (caudorostrally) of dorsal fin .....	1' 2½" = 368 mm.
Height of dorsal fin .....	8" = 203 mm.
Tip of rostrum to eye .....	2' ½" = 622 mm.
Tip of rostrum to proximal border of flipper .....	3' 11" = 1193 mm.
Tip of rostrum to anus .....	11' 3" = 3428 mm.
Diameter midway between flipper and dorsal fin .....	2' 11" = 888 mm.
Diameter at posterior edge of dorsal fin .....	2' 5" = 736 mm.
Length of flipper .....	1' 6¼" = 470 mm.
Width of flipper near base .....	5½" = 140 mm.
Greatest width of tail fluke .....	1' ¼" = 317 mm.
Length of single tail fluke (from caudal keel to tip) .....	1' 8½" = 520 mm.

The single, valvular blowhole was crescentic in shape with the horns pointing forward. It was located on top of the head, just in front of the eyes and just behind the rounded mass of nasal blubber which rose from

the beak to form the forehead. The throat grooves were deep and widely separated posteriorly. They were each one foot in length and followed the lines of the inferior maxillary bones to converge anteriorly just behind the mandibular symphysis.

On either side of the vulva there was an 80 mm. mammary slit.

#### *Internal Features*

*Soft Parts.*—The whale was covered with a layer of blubber which varied between 38 mm. and 44 mm. in thickness. The flesh was dark red (almost black), soft and full of tough fibers. The powerful muscles used in moving the tail flukes terminated in great tendons which, together with their fibrous coat, enmeshed the distal caudal vertebrae. This fibrous mass was so tough that it was impossible to cut up the tail in the field.

The single pair of small, sharp teeth, situated at the anterior end of the mandible, were entirely covered by the gums in life.

The greatly elongated laryngeal tube was superficially examined during the dissection of its supporting mechanism, the hyoid bones. It was not preserved. In its extreme length it agrees with that of *Mesoplodon bidens* described by Anthony and Coupin (1930). However, in the semilune outline of the lips of the epiglottis and supra-arytenoid cartilages, and in the constricted middle portion and expanded base of the tube, it more closely resembles Murie's description of the larynx of *Globiocephalus melas* (1873, p. 262). As with the blackfish, the lip of the supra-arytenoid cartilages is emarginate. In their conclusions, Anthony and Coupin state that the larynx of the Ziphoid whales closely resembles that of the Delphinidae.

The large, elongate lungs quite filled the thoracic cavity. Some of the soft, spongy lung tissue was preserved in formalin for study purposes. The huge, many-chambered stomach was empty save for a small amount of thick brown liquid.

*Skeleton.*—Except for the sixth rib on the left side, which accidentally was lost in the surf, the skeleton is complete.

The skull is remarkably similar to those of previously described females. It differs chiefly in having the extreme distal portion of the rostrum slightly decurved. In the specimens described by True (1913), Harmer (1924), Raven (1937) and Thorpe (1938), the inferior rostral outline is quite straight. In the Island Beach whale the inferior rostral outline is convex proximally and concave distally. In this respect it resembles *Mesoplodon europaeus*. Although the presphenoid is partially ossified, the remainder of the mesirostrum is entirely unossified. Although it does not hold for some of the species, I believe that the unossified mesirostrum is a female character of *M. mirus* and not necessarily an indication of immaturity. It is more than mere coincidence that, of the nine known specimens of *M. mirus*, the four definitely known to be females have the mesirostrum unossified while

in one definitely determined male, it is strongly ossified. This male, from Liscannor, County Clare, Ireland, has teeth much larger than those of known females. The specimen from Wells Beach, Maine, is said to be a male, but it has an unossified mesirostrum and the alveoli each measure approximately 30 mm. long by 13 mm. wide, indicating small teeth. I strongly suspect that this specimen is actually a female. The three unsexed specimens possess small teeth and two have the mesirostrum unossified, indicating that they are females.

TABLE II.—Skull Measurements of *M. mirus* (in millimeters)

	Type ♀ U.S.N.M.	New Jersey ♀ A.N.S.P.
1. Total length .....	810	800
2. Height, vertex to inferior borders of pterygoids .....	301	308
3. Width at center of orbits .....	325	354
4. Width across zygomatic processes .....	345	364
5. Width across occipital condyles .....	125	128
6. Rostrum, length from level of bases of anterior orbital notches .....	496	487
7. Rostrum, width between bases of anterior orbital notches .....	210	218
8. Rostrum, width at middle .....	60	59
9. Breadth of expanded proximal ends of premaxillae ...	142	147
10. Least breadth of premaxillae opposite anterior nares ..	118	109
11. Breadth of premaxillae opposite premaxillary foramina	68	73
12. Greatest breadth of anterior nares .....	56	63
13. Least distance between maxillary foramina .....	92	91
14. Distance from posterior border of maxillary foramen and end of maxillary protuberance .....	63	69
15. Length of portion of vomer visible on palate .....	162	180
16. Length of mandible .....	668	688
17. Length of symphysis .....	193	184
18. Greatest height of mandible at coronoid process .....	117	125

The small tympanic bones are not fused to the periotic bones and the latter are separate from the skull. The bullate portion of the left tympanic measures 41 mm. in length and 26 mm. in width just anterior to the lip-like process of the sinuous border. It is bilobate and rather straight-edged behind, and tapers to a rounded point in front. The lip-like process of the sinuous border flares out widely and the width of the left tympanic at this point is 34.5 mm. The left malleus was the only ossicle preserved. It was fused to the anterior border of the lip-like process of the sinuous border of the left tympanic by a slender 3.5 mm. process. Turner (1913, p. 18) noted a similar fusion in *Hyperoödon*. That part of the malleus termed the head by Turner, is reduced in this species to a tiny protuberance on the articular portion of the bone. The diameter of the conjoined head and articular portion is 5.5 mm. The two articular surfaces for the incus are set at right angles to each other.

The asymmetry of the skull, while easily discernible, is much less marked than in the type specimen. In this respect it agrees most closely with Raven's skull from Long Island. The pterygoid bones are broken, probably by the impact with which the animal struck the beach.

The right mandibular alveolus measured 30 mm. in length and 9 mm. in width. Fifteen millimeters of the small sharp-pointed tooth are visible. It projects forward and upward in the posterior portion of the large alveolus, so that there is a distance of 14 mm. between the tooth-tip and the anterior tip of the mandible.

*Hyoid bones.*—The hyoid bones agree very closely with those of Thorpe's specimen (1938, p. 359). The stylohyals are broken near the heads which articulate rather closely with the periotic element of the skull. The thyrohyals are firmly fused to the basihyal. Basihyal, length 57; width (maximum) 76. Thyrohyal, length 114; width (maximum) 38. Stylohyal, length 161; width (maximum) 41 mm.

*Vertebrae.*—The vertebral formula is C. 7; T. 10; L. 11; Ca. 18 = 46. All epiphyses are firmly fused to their centrums. The first three cervicals are fused together by both arches and centrums. The fourth and fifth cervicals are fused at their centrums and left arches. The first six cervicals have well-developed inferior lateral processes, but the last one has only slight projections. Cervicals 3 and 7 have well-developed superior lateral processes, and they are moderately developed in C. 4. Scarcely discernible in C. 5 and 6, they are absent in the atlas. The axis has none on the right side but the left process is moderately developed. In C. 6 the right and left portions of the neural arch do not join, but leave a gap of 10 mm. C. 7 bears a neural spine which is a continuation of the left side of the neural arch, the right portion not joining it but leaving a narrow gap of 1.5 mm.

Metapophyses begin on the third thoracic as with Thorpe (1938, p. 358) but end with the sixth caudal instead of the seventh. The first trace of an inferior median ridge appears on the eighth thoracic. From T. 3 to T. 7 it is better described as an inferior median groove.

The foramina piercing the inferior ridges of the caudals begin with Ca. 7 and continue beyond Ca. 11 to Ca. 12. A secondary ridge is barely discernible on the lateral anterior half of the centrums of the sixth and seventh caudals. The neural canal ends with the tenth caudal, where its diameter is about 2 mm. The foramina, which pierce the transverse processes of the sixth caudal and gradually assume a superior position as they continue to the seventeenth caudal, are very pronounced in that caudal. However, in the eighteenth and final caudal, which is very flattened and roughly triangular, they disappear completely.

There are nine chevrons. The small first chevron articulates between the last lumbar vertebra and the first caudal. The third and fourth chevrons

are quite large and much flattened on their ventral surfaces. The rest have a thin ventral edge. The third chevron is the largest and measures 160 mm. in length and 96 mm. in width.

*Ribs.*—The first seven pairs of ribs are dichcephalus. The last three pairs have only a single head. The tenth pair is very small, being only slightly more than one-third the length of the ninth pair. The ribs are broad and flat anteriorly, becoming narrow and rounded posteriorly. The third, sixth, eighth and ninth ribs on the right side and the seventh, eighth and ninth ribs on the left side are broken. Probably the breaking of these ribs had nothing to do with the death of this whale, although a collision with a ship has been suggested. There were no external injuries to the thoracic region and, since the ribs of these cetaceans are very brittle, it is quite possible that the shock of rolling on the beach broke them.

*Sternum.*—The sternum consists of four sternbrae, although the fourth segment is actually a composite bone resulting from the fusion of the fourth and fifth segments. In this respect it most resembles Harmer's specimen (1924, pl. 4). Total length of sternum, 550; manubrium, length, 225; manubrium, width, 168; depth of anterior notch, 47; xiphisternum (composite bone—product of fusion of third division of mesosternum and xiphisternum), length, 129; width, 83 mm. In the third segment the fontanelles are small. In the composite fourth segment, the anterior fontanelle is very small and sharply V-shaped. A small, round fontanelle in the center of this segment indicates the place of fusion of the fourth and fifth segments. This is further indicated by laterally projecting processes which are on a line with the central fontanelle and which are actually the posterior processes of the fourth segment. The fifth sternbra is asymmetrical, the left posterior process well developed and the right one totally lacking.

*Pectoral limb.*—The scapulae are similar to those already described. The coracoid process of the right scapula is broadly expanded at its free end while that of the left scapula is broader at the middle than at the free end. The preaxial border of the radius is convex proximally and concave distally. While articulating closely, the humerus, radius and ulna are not ankylosed. The epiphyses of the distal ends of the radius and ulna are not thoroughly fused to the bodies of the bones.

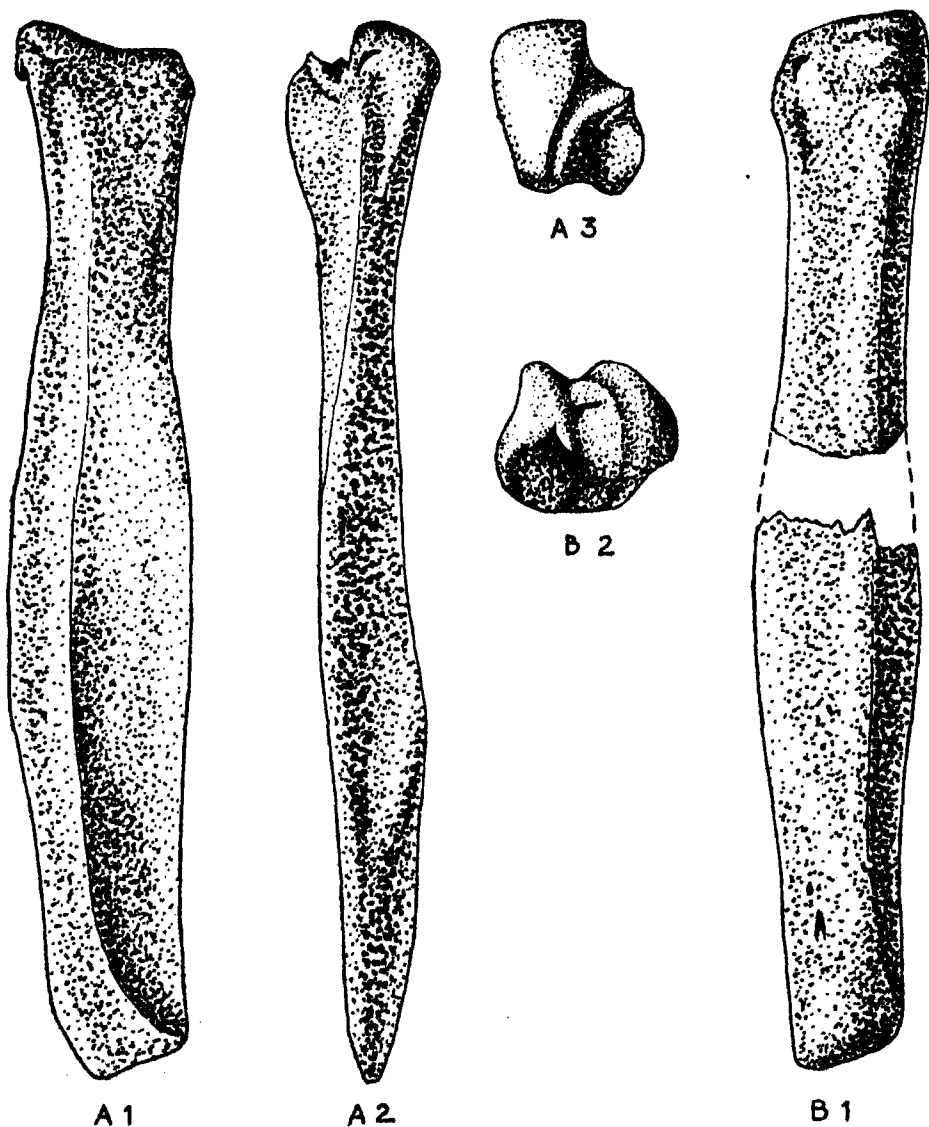
Raven (1937, p. 13) found the cuneiform and unciform elements to be distinct in *M. europaeus* and united in *M. mirus*. In the manus of the left pectoral limb of the Island Beach whale these elements are distinct while in the right manus they appear to be united.

The phalangeal formula is:

Right pectoral limb—I 2; II 5; III 4; IV 3; V 2.

Left pectoral limb—I 1; II 4; III 3; IV 3; V 2.

*Pelvic bones.*—Because of their small size, the pelvic bones of cetaceans are often overlooked. They have never been reported in *M. mirus*, although



Pelvic bones of ♀ *Mesoplodon mirus*, Island Beach, Ocean Co., New Jersey.

A.N.S.P. no. 20484. Twice natural size.

A1.—Lateral outer portion of right pelvic bone. A2.—Dorsal surface of same.  
A3.—Anterior end of right pelvic bone. B1.—Lateral outer portion of left pelvic bone.  
B2.—Anterior end of left pelvic bone.

they are known from other species of this genus as well as from *Ziphius*, *Hyperoodon* and *Berardius*. Thorpe (1938, p. 362) said that there were no pelvic bones present in his specimen of True's Beaked Whale. Mr. Raven writes that he has the pelvic bones of the Long Island *mirus* together with the genitalia.

In the Island Beach specimen, the pelvic bones were in close association with the genitalia. The relation of the pelvic bones to the vertebral column was not noted and it is suggested that those collecting cetaceans in the future should note carefully under which vertebra the pelvic bones are most directly situated and wire them to that vertebra in the field.

It is not difficult to ascertain approximately where the pelvic bones were located in the specimen under discussion. The distance from the tip of the beak to the anus was 11 feet and 3 inches. Measuring from the tip of the rostrum of the assembled skeleton to a point 11 feet 3 inches to the rear, we parallel the second caudal vertebra. Allowing for the tegument which covered the beak and for the inter-vertebral cartilages, the anus would be directly under the first caudal vertebra. Since the genital orifice is anterior to the anus, the pelvic bones were probably situated below the last lumbar and the first caudal vertebrae. Hale (1931, p. 305) describes the pelvic bones of *Hyperoodon planifrons* as situated below the last lumbar.

The pelvic bones of the Island Beach specimen are quite straight and rather stout. In this respect they differ considerably from those of other ziphoids which are slender and much curved. The anterior ends of these bones form rounded tubercles which are traversed dorso-ventrally by deep grooves. The bones are slightly constricted just behind their anterior tubercles and are wider nearer their centers. They are thickened dorsally while their ventral edges are quite thin. The posterior ends of the bones are not expanded and are cut off transversely. The undamaged right pelvic bone is 70 mm. long; 6.5 mm. in greatest dorsal thickness; 11.5 mm. in greatest lateral breadth.

Cetacean pelvic bones are very variable. Turner (1886, p. 178) records one 88 mm. long for a male *M. bidens*. Grieg (1897, p. 29) mentions one 36 mm. long for a young male of the same species. If the 14 mm. posterior cartilaginous process ossified, this 50 mm. bone would still fall far short of Turner's specimen.

Since the principal function of the pelvic bones is to give attachment to the crura of the penis or clitoris, they are usually larger in the male and therefore those of the male *M. mirus* should be much larger than those of the male *M. bidens*. I assume that the bones of the Island Beach whale represent the ischial element of the pelvic girdle.

Additional Notes on *Mesoplodon densirostris* from  
Corson's Inlet, New Jersey

The New Jersey specimen of Blainville's Whale was described by Roy Chapman Andrews (Proc. Acad. Nat. Sci. Phila., 1914, vol. 66, pp. 437-440). He mentioned that the whale had been dead a very short time. Since the very pelagic Ziphoïd whales are rarely seen alive, the following account by Mr. Henry Fowler, who collected the whale, may prove of interest.

"The discovery of the whale was due to Jacob Horn, at that time living at Corson's Inlet. It was first seen opposite the old hotel, lodged on a sand bar between the two railroad bridges. After it was sighted, seven men put off in two boats. A double hitch was made on the tail above the flukes, although it was not dead when found. It did not move until dragged into the water, when it towed the boat for about five hundred yards. The men then pulled it upon shore and, without a struggle, it died in the night. Mr. William Carruthers, who was in the party, shot at it with a rifle, but the bullets glanced off. Mr. James Mooney notified the Academy of its occurrence and it was due to his interest that the specimen was eventually secured for the museum."

Mr. Fowler tells me that this specimen was a male and that the penis was very prominent.

The maxillary protuberances are well developed in this skull. The anterior portions of the malar and frontal bones project well forward to form a deep anteorbital notch between them and the maxillary protuberance. The proximal portion of the thoroughly ossified mesirostrum bulges high above the premaxillae. A deep groove lies between the dorsal crests of the maxillae. The dorsal crest of the right maxillary bone is higher than that of the left. The nasal elements are small and indistinct. The proximal crests of the premaxillae extend forward over the anterior nares. The expanded proximal portion of the right premaxillary bone is about 30% wider than that of the left premaxillary. A lateral basirostral groove is barely discernible.

When figured by Andrews the tympano-periotic elements of the skull were in place. When recently examined, the tympanic bones were separated from both the skull and the periotic bones. Although the skull of the New Jersey *densirostris* is much smaller than that of the New Jersey *mirus*, its tympanic bones are much larger. The bullate portion of the left tympanic measures 51 mm. in length and 34 mm. in width just anterior to the lip-like process of the sinuous border. The lip-like process does not flare out as widely in this species as in *mirus*. The width of the left tympanic at this point is 41 mm. It agrees closely with True's figure of the



right tympanic of the *Annisquam* specimen (1910, pl. 34, fig. 1) and is only slightly larger.

From the broken edge of the anterior border of the lip-like process of the sinuous border, it would appear that the malleus had been here fused to the left tympanic bone. The only ossicle remaining when the skull was recently examined, was the left stapes which was firmly articulated to the fenestra ovalis of the petriotic bone. The stapes is stout with no sign of individual legs. The oval facet articulating with the incus is 2 mm. in diameter. The stapes is 4.5 mm. in length and rapidly expands toward its foot. The facet of the foot is 3.9 mm. in diameter and somewhat cupped.

TABLE III.—Skull Dimensions of *M. densirostris* (in millimeters)

♂ A.N.S.P. no. 20483

1.—Total length (beak slightly damaged) .....	692
2. Height, vertex to inferior border of pterygoids .....	292
3.—Width at center of orbits .....	315
4.—Vertical height of rostrum at middle .....	79
5.—Width across occipital condyles .....	104
6.—Rostrum, length from level of bases of anterior orbital notches .....	413
7.—Rostrum, width between bases of anterior orbital notches .....	170
8.—Rostrum, width at middle .....	52
9.—Breadth of expanded proximal ends of premaxillae .....	114
10.—Least breadth of premaxillae opposite anterior nares .....	90
11.—Breadth of premaxillae opposite premaxillary foramina .....	62
12.—Greatest breadth of anterior nares .....	41
13.—Least distance between maxillary foramina .....	50
14.—Distance from posterior border of maxillary foramen to end of maxillary protuberance .....	67
15.—Length of mandible .....	640
16.—Length of symphysis .....	162
17.—Greatest height of mandible at coronoid process .....	124

Andrews stated that the epiphyses of the vertebrae were firmly ankylosed to their centrams, but when the skeleton was recently examined, several were found to be separated. This would seem to indicate that a completely ossified mesirostrum does not necessarily indicate advanced age.

The skeleton now possesses 43 vertebrae. Caudals 10 and 17 appear to be missing. The vertebral formula is C. 7; T. 10; L. 11; Ca. 17 = 45.

The first three cervical vertebrae are completely fused and have a stoutly fused, neural spine. Inferior lateral processes of the centra are found in the first six cervicals. In the atlas and axis they are fused at their tips. The inferior lateral processes are large and broad in the sixth cervical. Superior lateral processes are found in all but the atlas, although they are much reduced in the fifth cervical. The superior lateral processes of the seventh cervical extend forward with expanded heads and correspond to the diapophyses of the first 7 thoracics. The fourth cervical has a complete

neural arch, but no spine. The arch of the fifth is incomplete, leaving a 23 mm. gap. The sixth cervical is similar to the seventh cervical of the Island Beach *mirus* in having a dorsal spine, but an incomplete neural arch. The two parts of the arch come within 1.5 mm. of joining and the right portion of the arch extends to form the spine which projects far forward. The seventh cervical has a complete arch and a well developed spine which leans forward. There is a backward facing facet on the lower side of the centrum of C. 7 for the articulation of the head of the first rib. Metapophyses are barely visible on the diapophyses of the third thoracic. They form rounded heads until T. 8 where they become flattened and so continue to the ninth caudal. Diapophysial facets occur on the first 7 thoracics and central facets occur on the first 6 thoracics, for the articulation of the dichoccephalic first 7 pairs of ribs. True transverse processes first appear on the eighth thoracic and continue to the sixth caudal. A faint inferior median ridge is present in all of the thoracics and it becomes very pronounced in the lumbar. In the last lumbar it changes into a double ridge with a deep groove between and this becomes deeper in the caudals and can even be detected in C. 16.

TABLE IV.—Skeletal measurements (in millimeters) of beaked whales

	<i>M. densirostris</i> A.N.S.P. no. 20483	<i>M. mirus</i> A.N.S.P. no. 20484
Total length of 7 cervical vertebrae .....	121	118
Total length of first 3 cervicals .....	51	57
Total length of last 10 caudals .....	—	438
Scapula, length .....	313	345
depth .....	214	233
Length of acromion in median line .....	88	98
Length of coracoid .....	91	92
Diameter of articular surface-anteroposterior .....	54	65
Diameter of articular surface-traverse .....	39	41
Humerus, length .....	128	137
maximum width .....	56	70
Radius, length .....	157	168
maximum width .....	43	46
Ulna, length .....	175	183
maximum width, upper end .....	61	62
maximum width in center .....	27	22.5

The transverse processes of the lumbar vertebrae are long anteriorly and gradually become short and broad. They turn slightly downward. The centra increase in length posteriorly and the ninth lumbar is the longest. After that they decrease in length.

The ninth caudal has a small neural spine and Ca. 11 has none. A lateral ridge is present on the centra of caudals 2 to 7. It is much less pronounced than in *M. mirus*. The inferior double ridge of caudals 6 to 9 is pierced by a foramen.

The neural canal is very small in the ninth caudal and probably ends in the missing tenth.

The epiphyses of the distal ends of the radius and ulna are not fused to the bodies of the bones. The cuneiform and unciform elements of the manus are distinct.

The hyoids and pelvic bones of this whale were not collected.

These measurements clearly show that, although the skulls of *M. mirus* and *M. densirostris* are very different, their skeletons do not vary nearly so much.

#### RECORDS OF ZIPHOID WHALES ON THE ATLANTIC COAST OF NORTH AMERICA

##### *Mesoplodon bidens*

Nantucket Island, Massachusetts. 1867. Skull in the Museum of Comparative Zoölogy, Cambridge, Massachusetts. Louis Agassiz, Proc. Boston Soc. Nat. Hist., vol. 11, 1866-68, p. 318.

##### *Mesoplodon europaeus*

Atlantic City, New Jersey. March 28, 1889. Young male. Skeleton, cast, and viscera in the United States National Museum, Washington, D. C. W. Turner, Proc. Roy. Physic. Soc. Edinburgh, vol. 10, 1888-89, p. 13.

Rockaway Beach, N. Y. December 22, 1933. Female. Skeleton in the American Museum of Natural History, New York. H. C. Raven, Amer. Mus. Nov., no. 905, 1937, p. 2.

Middle Key, Florida. 1935. Skull in the American Museum of Natural History, New York. H. C. Raven, Amer. Mus. Nov., no. 905, 1937, p. 7.

##### *Mesoplodon densirostris*

Annisquam, Massachusetts. August, 1898. Young female. Skeleton in the Museum of the Boston Society of Natural History, Boston, Massachusetts. Alpheus Hyatt, Proc. Boston Soc. Nat. Hist., vol. 29, 1899, p. 9.

Corson's Inlet, New Jersey. June 18, 1913. Male. Skeleton at the Academy of Natural Sciences of Philadelphia, Philadelphia, Penna. R. C. Andrews, Proc. Acad. Nat. Sci. Phila., vol. 66, p. 437.

Bogue Banks, near Beaufort, North Carolina. January 1923. Rostral portion of skull in United States National Museum, Washington, D. C.

Peggy's Cove, Halifax County, Nova Scotia. February 4, 1940. Specimen in the American Museum of Natural History, New York. R. A. McKenzie, Proc. Nova Scotian Inst. Sci., vol. 20, 1939-40, pt. 2, p. 46.

(Identified by H. C. Raven, who has notes on its anatomy almost ready for publication.)

*Mesoplodon mirus*

Beaufort Harbor, North Carolina, July 26, 1912. Female. Type. Skull and partial skeleton in the United States National Museum, Washington, D. C. F. W. True, Proc. U. S. Nat. Mus., vol. 45, 1913, p. 651.

Wells Beach, Maine. March 2, 1906. Male. (?) Skeleton and cast in the Museum of the Boston Society of Natural History, Boston, Massachusetts. H. C. Raven, Amer. Mus. Nov., no. 905, 1937, p. 16.

Edgemere, Rockaway Beach, New York. January 14, 1934. Adult female. Skeleton and soft parts in the American Museum of Natural History, New York. H. C. Raven, Amer. Mus. Nov., no. 905, 1937, p. 16.

Mason Island, off Mystic, Connecticut. November 19, 1937. Female. Skeleton in the Yale Peabody Museum, New Haven, Connecticut. M. R. Thorpe, Journ. Mamm., vol. 19, 1938, p. 354.

South Gut, St. Anne's Bay, Cape Breton Island, Nova Scotia. August 5, 1938. Female (?). Skull in the Museum of Comparative Zoölogy, Cambridge, Massachusetts. G. M. Allen, Journ. Mamm., vol. 20, 1939, p. 259.

Island Beach, below Seaside Park, New Jersey. January 9, 1940. Female. Skeleton at the Academy of Natural Sciences of Philadelphia, Philadelphia, Penna.

*Mesoplodon species*

North Long Branch, New Jersey. July 22, 1905. Adult female. Skull (damaged) in the Museum of Comparative Zoölogy, Cambridge, Massachusetts. G. L. Allen, Amer. Nat., vol. 40, 1906, p. 357.

(Dr. Harry C. Raven says that this skull resembles *mirus* somewhat but that it definitely is not *europaeus*.)

*Ziphius cavirostris*

Charleston, South Carolina. 1865. (?). Young female. Skeleton in the United States National Museum, Washington, D. C. (Type of *Hyperodon semijunctus* Cope.) E. D. Cope, Proc. Acad. Nat. Sci. Phila., vol. 17, 1865, p. 280.

Barnegat City, Ocean County, New Jersey. October 3, 1883. Adult female. Skeleton and cast in the United States National Museum, Washington, D. C. F. W. True, Bull. U. S. Nat. Mus., no. 73, 1910, p. 33.

St. Simon Island, Georgia. 1893. Male (?). Known from a photograph; only a few bones preserved. F. W. True, Bull. U. S. Nat. Mus., no. 73, 1910, p. 31.

Newport, Rhode Island. October 1901. Adult male. Skeleton in the United States National Museum, Washington, D. C. F. W. True, Bull. U. S. Nat. Mus., no. 73, 1910, p. 32.

Long Beach, Long Island, New York. August 15, 1914. Female. Skeleton in the American Museum of Natural History, New York. R. H. Rockwell, Brooklyn Mus. Quart., vol. 1, no. 3, 1914, p. 147.

Long Beach, Long Island, New York. August 15, 1914. Foetus at term. Skeleton in the American Museum of Natural History, New York. R. H. Rockwell, Brooklyn Mus. Quart., vol. 1, no. 3, 1914, p. 147.

(The unpublished diary of W. J. Hoxie records that a "*Hyperödon vastratus*" [probably *Ziphius cavirostris*], a female, length 20 feet, containing a foetus, was found at Canaveral, Florida, August 21, 1888.)

*Hyperödon ampullatus*

North Dennis, Massachusetts. January, 1869. Male. Skeleton in the Museum of Comparative Zoölogy, Cambridge, Massachusetts. J. A. Allen, Bull. Mus. Comp. Zoöl., vol. 1, 1869, p. 205.

Narragansett Bay near Tiverton, Rhode Island. 1867. Female. Skull and "other bones" at the Academy of Natural Sciences of Philadelphia, Philadelphia, Penna. E. D. Cope, Proc. Acad. Nat. Sci. Phila., vol. 21, 1869, p. 31.

(DeKay in his "Zoology of New York", 1842, vol. 1, p. 131, records an eighteen-foot, female specimen, from "the lower bay of New York." However, because of the confusion that formerly existed amongst the Ziphiidae, little faith can be put in this record. The same holds true for Linsley's record of the Bottle-nosed Whale at Stonington, Connecticut. Amer. Journ. Sci., vol. 43, 1842, p. 353.)

Key to the Ziphioid Whales of the Atlantic Coast of North America

Family **ZIPHIIDAE**—Beaked Whales

Small to medium sized whales ranging up to forty-one feet. Rostrum compressed, solidified and extended into a beak. Two grooves on the throat converge anteriorly to form a V. The pectoral flippers are small and the dorsal fin is placed well back of the middle of the body. No notch in the posterior border of the tail flukes. Teeth usually absent in the skull and reduced to one or two pairs in lower mandible. The mandibular teeth may or may not be exaggerated in shape and size.

- a. A pair of teeth at anterior end of mandible.

- b. Beak of skull with high crests formed by the elevation of the maxillary bones on either side of the premaxillae anterior to the dorsal narial aperture.  
*Hyperoodon ampullatus* (Forster)—Bottle-nosed Whale
- bb. Maxillary bones not greatly elevated anterior to dorsal narial aperture.
- c. Mandibular symphysis less than one-fourth of total length of mandible. Nasals large, extending forward to partially cover the dorsal narial aperture from above. Shallow lateral basirostral groove present.  
*Ziphius cavirostris* G. Cuvier—Cuvier's Beaked Whale
- cc. Mandibular symphysis more than one-fourth of total length of mandible. Nasals small, not extending forward over narial aperture. Lateral basirostral groove absent.  
*Mesoplodon mirus* True—True's Beaked Whale
- aa. No teeth at anterior end of mandible.
  - d. A single pair of teeth opposite mandibular symphysis.  
*Mesoplodon europaeus* (Gervais)—Gervais' Beaked Whale
  - dd. A single pair of teeth posterior to mandibular symphysis.
    - e. Medium-sized, compressed teeth just back of symphysis. Alveolus lower than coronoid process. Rostrum vertically thin.  
*Mesoplodon bidens* (Sowerby)—Sowerby's Beaked Whale
    - ee. Each large, compressed tooth situated slightly anterior to centre of mandible. Alveolus higher than coronoid process. Rostrum thickened vertically.  
*Mesoplodon densirostris* (Blainville)—Blainville's Beaked Whale

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#### EXPLANATION OF PLATES 20 AND 21

##### PLATE 20.

Upper figure.—True's Beaked Whale, *Mesoplodon mirus*, ♀, Island Beach below Seaside Park, Ocean County, New Jersey, February 28, 1940. A.N.S.P. 20484.

Lower figure.—Same. Mammary slits.

##### PLATE 21.

True's Beaked Whale, *Mesoplodon mirus*, ♀, Island Beach, below Seaside Park, Ocean County, New Jersey, February 28, 1940. A.N.S.P. 20484.

Upper left.—Profile.

Upper right.—Beak and blowhole.

Lower left.—Throat Grooves.

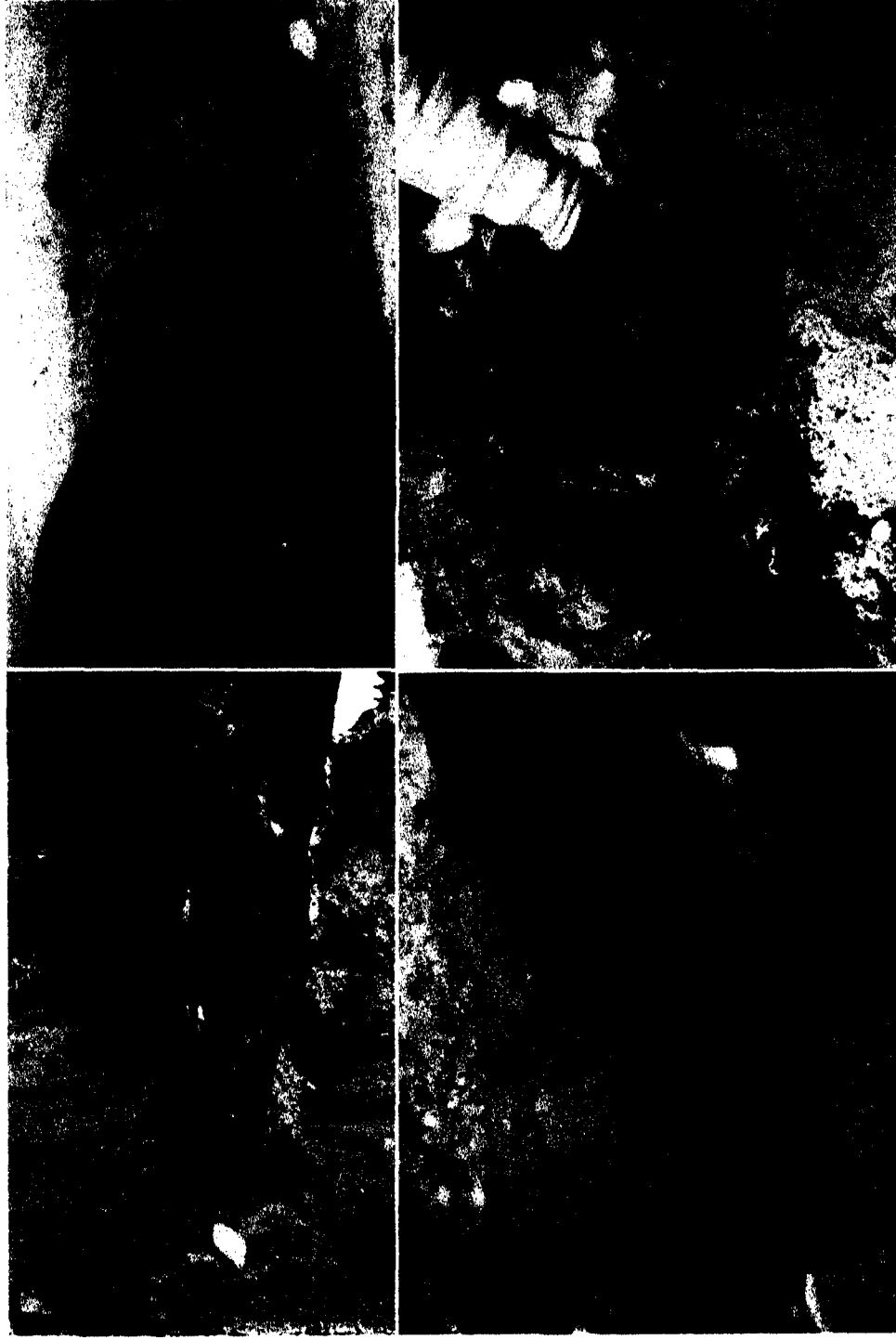
Lower right.—Laryngeal tube (closed). Note left stylohyal articulating to the skull above and to the left.



ULMER: MESOPLONDON MIRUS IN NEW JERSEY, WITH ADDITIONAL  
NOTES ON THE NEW JERSEY M. DENSIROSTRIS, AND A LIST  
AND KEY TO THE ZIPHOID WHALES OF THE  
ATLANTIC COAST OF NORTH AMERICA







ULMER: MESOPLODON MIRUS IN NEW JERSEY, WITH ADDITIONAL NOTES ON THE NEW JERSEY  
M. DENSIROSTRIS, AND A LIST AND KEY TO THE ZIPHOID WHALES OF THE  
ATLANTIC COAST OF NORTH AMERICA



# A COLLECTION OF FRESH-WATER FISHES OBTAINED IN EASTERN BRAZIL BY DR. RODOLPHO VON IHERING

BY HENRY W. FOWLER

*Curator of Fishes, The Academy of Natural Sciences of Philadelphia*

The collection reported here was sent to the Academy in 1937 by the late Dr. Von Ihering, containing 823 specimens representing 104 species, of which 36 are new or undescribed. Many are from Ceará, Lago Papary in Rio Grande do Norte, the Rio Jaguaribe, The Rio São Francisco and its drainage area, Pernambuco and Therezina in Piahy, and the Rio Parnahyba. Interesting vernacular names are given for most of the species, or where they could be ascertained, and are indicated by quotations.\* We are gratified by Dr. von Ihering's care and industry in forming this valuable collection and in contributing a most desired accession to our department of ichthyology.

All the new forms are described and figured. A few descriptions and figures are also given of rare or noteworthy species. References are only cited for the original descriptions, besides one or more pertaining to Academy materials or affording clues to the more detailed literature.

## DASYATIDAE

*Potamotrygon signatus* Garman

Figure 1.

*Potamotrygon signatus* Garman, Mem. Mus. Comp. Zool., vol. 36, 1913, p. 420 (type locality, Rio Poty, tributary of the Parahyba River, Brazil; San Goncallo).

Disk slightly elliptical in contour, little longer than broad, outer profiles of body each forming evenly convex. Tip of snout very short, broad point in front profile. Snout twice as long as firm interorbital space. Eyes prominent, smaller than spiracles. Mouth small, curved, width 3 in preorbital space, with 5 lower inner papillae. Teeth in about 22 rows in each jaw, small, rhomboid, each with longitudinal keel. Second and third gill openings largest or long as eye, last smallest.

Skin largely smooth. Entire upper median surface of disk asperous and extends into interorbital space. Snout and broad margin of disk above all around smooth. Lower surface all around mouth more or less papillate. Irregular row of about 18, several double, large median spines down tail to serrated caudal spine, which is  $1\frac{1}{2}$  in snout; sides of tail naked. Tail behind spine compressed, with broader membranous keel above, lower one half as deep.

Color in alcohol brown, paler or lighter to whitish below. Entire upper surface of disk comprised chiefly in asperous area with very various dark rootlet-like lines; forward they extend only into hind part of snout, though

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\* Locality names follow the spelling used by Dr. Von Ihering in his manuscript list of specimens.

along sides of disk may extend more or less to margins. Tail and ventrals chiefly above and on lower surface of former posteriorly with variable large diffuse dark to blackish blotches. Spine uniformly light. Eye gray-black. Spiracle dark brown.

One 368 mm., of which disk length is 195 mm., from Ceará.

### ENGRAULIDAE

*Anchoviella iheringi* new species

Figure 2.

Depth  $4\frac{3}{4}$  to 5; head  $3\frac{1}{2}$  to  $4\frac{1}{2}$ , width  $2\frac{1}{2}$  to  $2\frac{3}{4}$ . Snout 5 to  $5\frac{1}{2}$  in head, short, convex; eye 3 to  $3\frac{1}{2}$ , greater than snout or interorbital, without free edges and investing adipose membranes moderate; maxillary reaches back to ridge of preopercle but not to its hind edge, length from snout tip  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in head; mouth cleft long, front end of mandible extending forward half way in snout length; teeth minute, uniserial and uniform in jaws, extend all along lower maxillary edge; interorbital  $4\frac{1}{2}$  to  $4\frac{3}{4}$  in head, moderately elevated, convex; cheek as bounded behind by preopercle ridge forms nearly equilateral triangle. Gill rakers  $14 + 19$ , slender, lanceolate; gill filaments  $\frac{3}{4}$  of gill rakers, which are  $1\frac{1}{2}$  in eye.

Scales very caducous, most all lost,  $30 + 3$  (pockets) in axial lateral series; 9 transversely between dorsal base and anal origin; 16 predorsal. Caudal largely scaly from base. Dorsal with broad scaly sheath, also anal. Axillary ventral scale  $1\frac{1}{2}$  in fin. Pectoral with long pointed axillary scale  $\frac{1}{2}$  length of fin.

D. III, 12, first branched ray  $1\frac{3}{4}$  to  $1\frac{5}{6}$  in head; A. III, 20, 1, to III, 22, 1, first branched ray  $1\frac{3}{4}$  to 2; least depth of caudal peduncle  $2\frac{1}{4}$  to 3; caudal 1, deeply forked, lobes pointed; pectoral  $1\frac{1}{2}$ , rays I, 12; ventral rays 1, 6, fin  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in head.

Color in alcohol brown, generally uniform. A contrasted broad opaque white lateral axial band, a little wider on costal region though not wider than eye, and narrowing slightly along side of caudal peduncle; band without dark bordering lines. Sides of head with traces of bright silvery white, especially cheek and opercle. Iris silvery white. Fins uniformly pale, with all of hind caudal edge blackish gray.

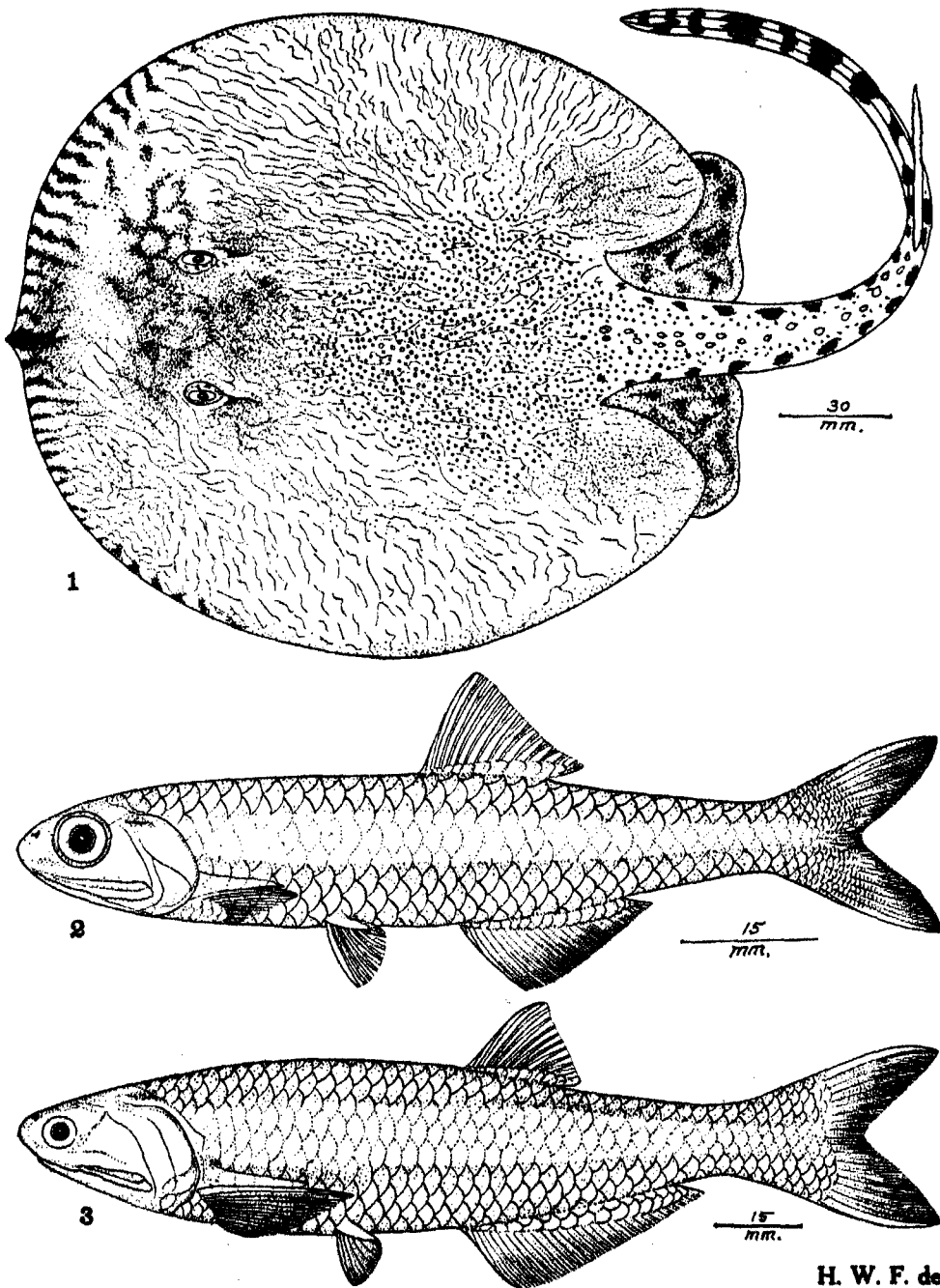
A. N. S. P. no. 69345. Rio Jaguaribe, Brazil. Length 100 mm. Type.

A. N. S. P. nos. 69346 to 69368, same data, paratypes. Length 80 to 98 mm.

Resembles *Ampluva vaillanti* (Steindachner)<sup>1</sup> though that species is said to have the dorsal origin always premedian in the standard length, and the anal origin below the last dorsal ray. The silver gray lateral band is called sharply defined though its width is not indicated. Its structural details are also at variance.

(For Dr. Rodolpho von Ihering.)

<sup>1</sup> *Engraulis vaillanti* Steindachner. Anzeiger Akad. Wiss. Wien, vol. 45, nr. 11, 1908, p. 193 (type locality, "Rio San Francisco nächst Joazeira und Barra an seichten Uferstellen, im Rio grande do Norte und Rio Preto").



H. W. F. del.

FIG. 1.—*Potamotrygon signatus* Garman. FIG. 2.—*Anchoviella iheringi* new species.  
FIG. 3.—*Pterengraulis atherinoides* (Linnaeus).

**Anchoviella pallida** (Starks)

*Anchovia pallida* Starks, Stanford Univ. Publ., Univ. ser., March 17, 1913, p. 9, pl. 1 (type locality, "market at Para").

*Anchoviella venezuelae* Fowler, Proc. Acad. Nat. Sci. Phila., vol. 83, 1931, p. 406, fig. 6 (type locality, Caño Guanoco, Venezuela).

Depth  $3\frac{1}{2}$ ; head  $3\frac{1}{2}$ , width  $3\frac{1}{2}$ . - Snout  $5\frac{1}{2}$  in head; eye  $4\frac{1}{2}$ , greater than snout, slightly greater than interorbital; maxillary extends  $1\frac{1}{2}$  eye diameters behind eye, not quite to preopercle ridge or mandibular articulation, length from front end  $1\frac{1}{2}$  in head; teeth uniserial, even and very fine in each jaw, extend along entire lower maxillary edge; interorbital  $4\frac{1}{2}$  in head, convex. Gill rakers  $40+58$ , long as eye; gill filaments  $\frac{1}{2}$  long as gill rakers.

Scales  $33+4$  in axial lateral series; 9 transversely, 16 predorsal. Rather narrow basal scaly sheath along dorsal. Anal with broad scaly basal sheath, much higher anteriorly. Caudal base scaly, without alar scales, and small scales extend well out on each lobe. Axillary pectoral scale half length of fin. Scales with 13 transverse vertical striae, of which only 3 or 4 complete, others marginal.

D. II, 10, 1, third simple ray  $1\frac{1}{2}$  in head; A. III, 22, first branched ray  $2\frac{1}{2}$ ; caudal  $1\frac{1}{2}$ , lobes even, pointed; least depth of caudal peduncle  $2\frac{1}{2}$ ; pectoral 14, rays I, 13; ventral rays I, 6, fin  $3\frac{1}{2}$  in head.

Color in alcohol pale or light brown generally. Snout pale. Iris white. Silvery white lateral band, narrow as pupil at first or along upper side of trunk, expands along side of tail till little wider than eye and narrows a little just before caudal base. Fins all dull or pale brown. Front edge of dorsal dark brown. Hind edge of each caudal lobe blackish gray.

One, 104 mm., Ceará. This specimen is interesting as showing a distinct silvery lateral band, not prominent, and which I suspect may have been intensified due to the action of the formalin in which it was originally preserved. Though with still more gill rakers and fewer scales than Starks gives, it appears to agree in most every other way. My figure of *Anchoviella venezuelae* shows the anal scales too small and crowded, whereas they are large and in a single basal row. Neither the figure given by Starks or my own figure show the scales encroaching as far out over the caudal as in this specimen.

**Pterengraulis atherinoides** (Linnaeus) "Sardinha."

Figure 3.

*Clupea atherinoides* Linnaeus, Syst. Nat., ed. 12, pt. 1, 1766, p. 523 (type locality, Surinam).—Bloch, Naturg. Ausland. Fische, vol. 9, 1795, p. 46, pl. 408 (Atlantic; Surinam).

*Pterengraulis atherinoides* Fowler, Proc. Acad. Nat. Sci. Phila., 1911, p. 220 (Surinam).—Starks, Stanford Univ. Publ., Univ. ser., March 17, 1913, p. 10 (Para).—Fowler, Proc. Acad. Nat. Sci. Phila., Sept. 9, 1919, p. 128 (Surinam specimen).—Jordan and Seale, Bull. Mus. Comp. Zool., vol. 67, no. 11, May 1926, p. 386 (Para; Cameta; Arary).—Fowler, op. cit., 1931, p. 407 (Caño Guanoco, Venezuela).

Five, 130 to 153 mm., Rio Jaguaribe, Russas, Ceará.

## SYNBRANCHIDAE

**Synbranchus marmoratus** Bloch "Mussum."

*Synbranchus marmoratus* Bloch, *Naturg. Ausland. Fische*, vol. 9, 1795, p. 87, pl. 418 (type locality, Surinam).—Fowler, *Proc. Acad. Nat. Sci. Phila.*, 1912, p. 8 (Peru; Pebas; Ambyiacu R.; Surinam; R. Grande do Sul; São João to R. Negro and Chapada); 1915, p. 531 (Trinidad); 1919, p. 129 (Surinam examples); 1926, p. 256 (Para); 1931, p. 395 (Brighton, Trinidad); vol. 91, 1939 (Feb. 20, 1940), p. 285 (reference).

*Synbranchus marmoratus* Eigenmann, *Mem. Carnegie Mus.*, vol. 5, June 1912, p. 443 (Rupununi; Rockstone).—Starks, *Stanford Univ. Publ., Univ. ser.*, March 17, 1913, p. 12 (L. Papary; Ceará Mirim).

One, 931 mm., Rio Cocó, Fortaleza, Ceará in 1936.

## PIMELODIDAE

**Pimelodella gracilis** (Valenciennes)

*Pimelodus gracilis* Valenciennes, *Voy. Amer. Mérid. d'Orbigny*, vol. 5, 1847, p. 7, pl. 2, fig. 5 (type locality, "Amérique meridionale").

? *Pimelodella gracilis* Eigenmann, McAtee, Ward, *Ann. Carnegie Mus.*, vol. 4, no. 2, 1907, p. 114, pl. 32, fig. 2 (photograph) (Corumbá; L. Ipacarái).

*Pimelodella gracile* Fowler, *Proc. Acad. Nat. Sci. Phila.*, May 29, 1914, p. 263, fig. 13 (Rupununi R.); May 28, 1915, p. 264 (Barro Alto, Ceará).

Three, 113 to 140 mm., Fortaleza, Ceará. These all with an underlaid livid dark gray axial line along side of body, but not extended forward on the head. The barbels appear to mostly reach the ventrals, and only in the smallest one reaches nearly to the caudal. Dorsal spine but little less than pectoral spine, in no case with any barbs on the inner edge and only a few obsolete ones terminally on the outer edge. Pectoral spine with antrorse denticles along inner edge, extending to terminal fourth. Caudal lobes apparently subequal.

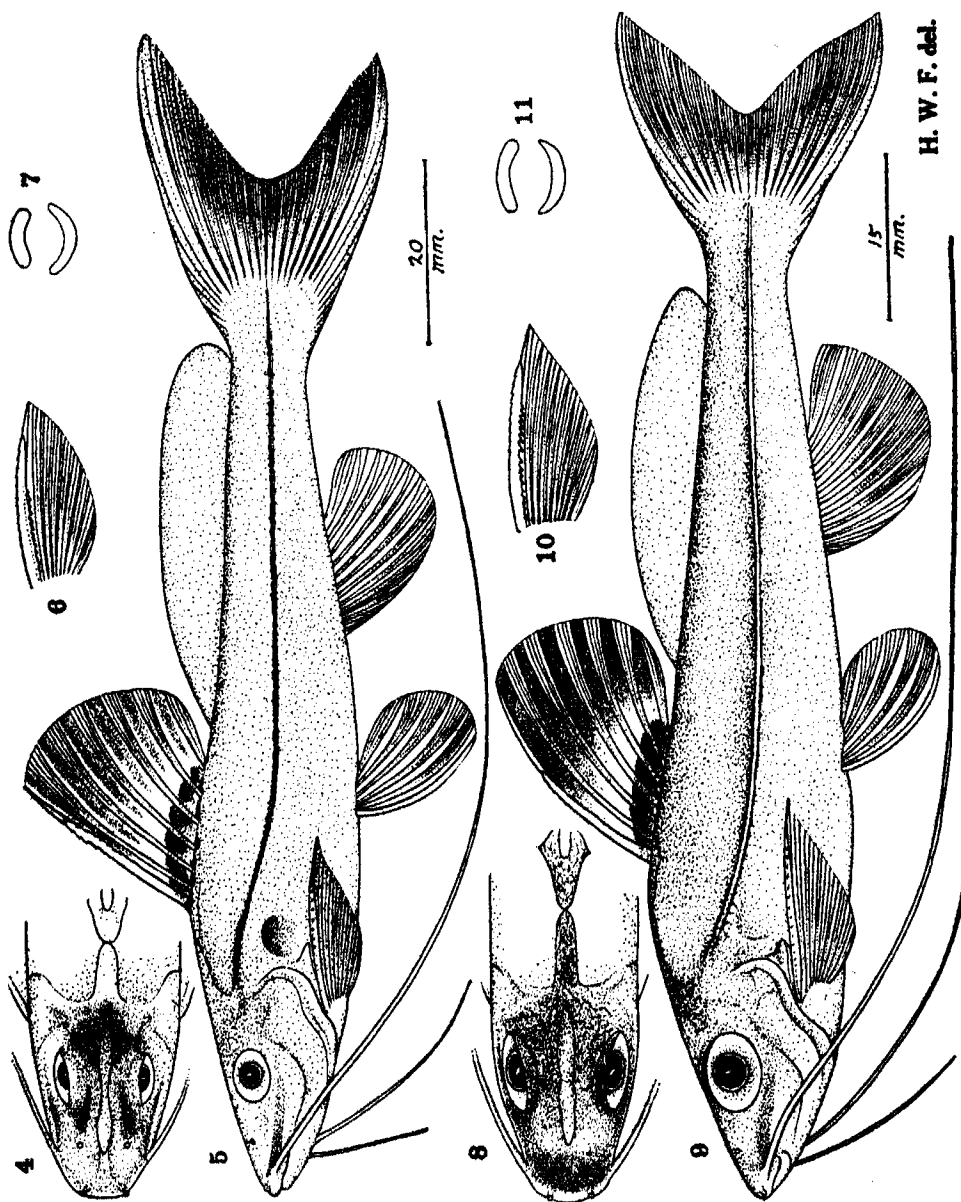
**Pimelodella dorseyi** new species

Figures 4 (head above), 5 (lateral view), 6 (pectoral fin) and 7 (dental plates).

Dopth 5 to  $5\frac{1}{2}$ ; head  $4\frac{1}{4}$  to  $4\frac{1}{2}$ , width  $1\frac{3}{4}$  to  $1\frac{1}{2}$ . Snout (in profile)  $2\frac{3}{4}$  to  $2\frac{1}{2}$  in head; eye 4 to  $4\frac{1}{4}$ ,  $1\frac{3}{4}$  to  $1\frac{1}{2}$  in snout, equals bony interorbital, lids free all around; mouth width  $2\frac{1}{4}$  to  $3\frac{1}{8}$  in head, cleft extending  $\frac{3}{4}$  to eye, closed lower jaw included in upper; maxillary barbel reaches  $\frac{3}{4}$  to  $\frac{1}{2}$  in adipose fin, outer mental barbel  $\frac{1}{2}$  to  $\frac{1}{4}$  in pectoral, inner mental barbel  $\frac{3}{4}$  to  $\frac{1}{2}$  to pectoral; lips firm, smooth, narrow and lower with short lateral sulcus leaving median entire region  $\frac{3}{4}$  extent of mouth width; teeth villiform, simple, fine, in rather narrow bands, uniform and similar in jaws, without backward extension; no teeth on palate; bony interorbital width low, depressed, level; frontal fontanel moderate, narrow behind and reaches base of occipital extension; bony bridge complete to dorsal; width of supraoccipital extension 3 in its length. Gill rakers 5+9, lanceolate,  $\frac{1}{2}$  of gill filaments, which are 2 in eye.

Skin smooth. Lateral line distinct, complete, axial, reaches middle of caudal base. Humeral extension smooth, length 2 to  $2\frac{1}{4}$  in depressed pectoral fin. All bones on top of head covered with thin skin and smooth.



FIGS. 4 to 7.—*Pimelodella dorseyi* new species.FIGS. 8 to 11.—*Pimelodella parnahybae* new species.

D. I, 6, spine pungent, front edge with 10 antrorse low points on terminal half, hind edge with 8 low points also on terminal half, basal portions of spine edges entire; adipose fin length  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in fish without caudal; caudal deeply forked, lobes sharply pointed, length  $3\frac{1}{4}$  to  $3\frac{3}{4}$ ; least depth of caudal peduncle 3 to  $3\frac{1}{2}$  in head; A. v, 10, second branched ray  $1\frac{9}{10}$  to 2; pectoral  $1\frac{1}{4}$ , rays I, 8, spine broad, compressed, front edge with 12 low antrorse points on terminal  $\frac{2}{3}$  and hind edge with 15 moderate denticles on basal  $\frac{2}{3}$ ; ventral  $1\frac{3}{4}$  in head, rays I, 5.

Color in alcohol brown, little paler to whitish below. Top of head behind eyes and each side of frontal fontanel with dark suffusion. Narrow dark brown line close along lateral line above and below along its whole extent to caudal base. Grayish suffusion above pectoral and behind gill opening. Each barbel with a brown bordering edge above. Iris grayish. Lips pale. First dorsal very pale, each membrane with dark grayish terminally; grayish subbasal band present. Other fins largely pale to whitish and lower lobe of caudal terminally dark gray.

A. N. S. P. no. 69375. Rio Salgade, Icó, Ceará. Length 124 mm. Type.

A. N. S. P. no. 69376, same data, paratype. Length 122 mm.

Known by its uniform coloration and with only a very narrow dark axial lateral band embracing the lateral line. Its structural characters in combination as the long maxillary barbels, armature of the dorsal and pectoral spines, and other features are diagnostic.

(For Mr. Lewis M. Dorsey, Jr., of Philadelphia, to whom I am indebted for local fishes.)

***Pimelodella parnahybae* new species**

Figures 8 (head above), 9 (lateral view), 10 (pectoral spine) and 11 (dental plates).

Depth  $4\frac{1}{2}$ ; head 4, width  $1\frac{3}{4}$ . Snout (in profile)  $2\frac{1}{2}$  in head; eye  $3\frac{1}{10}$ ,  $1\frac{1}{2}$  in snout, greater than interorbital, upper edge free; mouth width  $2\frac{1}{10}$  in head, cleft extends  $\frac{1}{2}$  to eye, lower jaw shorter and slightly included in upper jaw; maxillary barbel reaches middle of caudal base, outer mental barbel  $\frac{2}{3}$  in depressed pectoral or to end of pectoral spine, inner mental barbel  $\frac{1}{2}$  in depressed pectoral fin; rather narrow band of fine villiform teeth in each jaw, with ends of lower band more angulate; interorbital 4 in head, low, flat; frontal fontanel extends from slightly behind posterior internarial back to base of occipital extension, which reaches dorsal plate forming complete bony bridge. Gill opening extends forward opposite front eye edge. Gill rakers 2+7, slender, lanceolate  $\frac{2}{3}$  of gill filaments, which are  $\frac{1}{2}$  of eye.

Skin smooth. Occipital bones slightly striate, also occipital extension and dorsal buckler. Humeral extension very short, obtuse,  $3\frac{1}{2}$  in depressed pectoral fin. Lateral line complete, distinct, axial along side of body.

D. I, 6, I, slender spine with 6 low inconspicuous antrorse serrae on terminal half of outer edge and basal half with edge entire, hind edge with 9 low serrae on terminal  $\frac{2}{3}$  of spine, spine length  $1\frac{1}{2}$  in head, first branched ray 1; adipose fin rather high, length  $2\frac{1}{2}$  in fish without caudal; A. v, 8, I, first branched ray  $1\frac{1}{2}$  in head; caudal  $3\frac{1}{2}$  in rest of fish, deeply forked; least depth of caudal peduncle 3 in head; pectoral  $1\frac{1}{2}$ , spine with 11 antrorse

serrae on terminal  $\frac{3}{4}$  of outer edge and rest of edge basally entire, inner edge with 16 denticles on all but entire terminal fourth, rays I, 9; ventral  $1\frac{1}{2}$  in head, rays I, 5.

Color in alcohol largely uniform brown. Iris dark gray. Barbels brown. Fins brown. Dorsal with dark brown terminally on each membrane and also darker basal blotch on each as well.

A. N. S. P. no. 69377. Rio Parnahyba, Therezina, Piahy. 1936. Length 95 mm. Type.

Known by its conic and greatly compressed head and body, and the very large eye. Along the lateral line a dark line close above and another close below for its entire extent. In its long barbels the species approaches *Pimelodella hartwelli* Fowler from Peru, as well as *Pimelodella dorseyi* described above.

(For the Rio Parnahyba.)

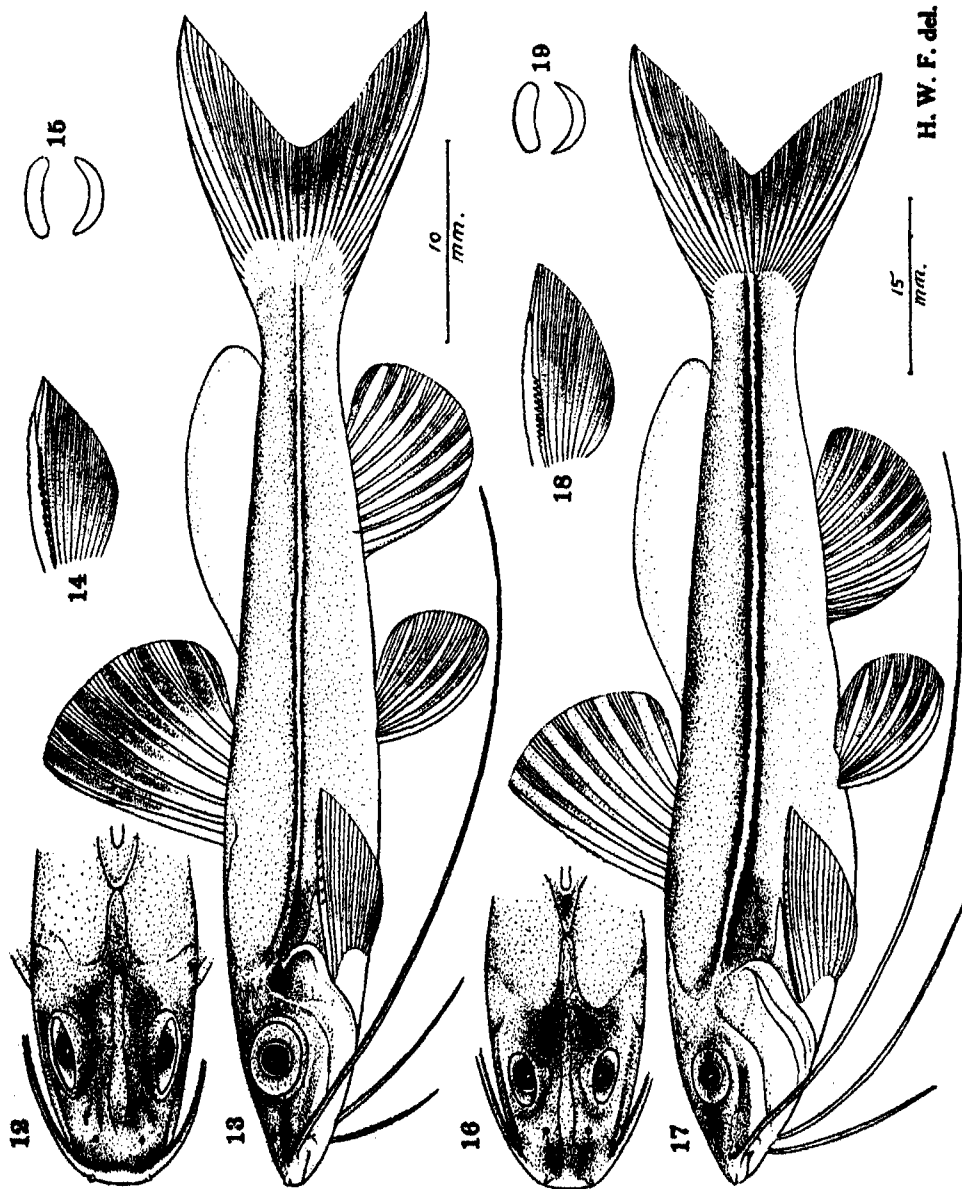
*Pimelodella enochi* new species "Mandy Chorão." Figures 12 (head above), 13 (lateral view), 14 (pectoral fin) and 15 (dental plates).

Depth  $5\frac{2}{10}$  to  $6\frac{1}{2}$ ; head  $3\frac{3}{4}$  to  $3\frac{5}{8}$ , width  $1\frac{3}{8}$ . Snout (in profile)  $2\frac{3}{4}$  to  $2\frac{1}{2}$  in head; eye  $3\frac{1}{4}$  to  $3\frac{1}{2}$ ,  $1\frac{1}{4}$  to  $1\frac{1}{2}$  in snout, greater than bony interorbital, eyelids free all around; mouth width  $2\frac{1}{4}$  to  $2\frac{1}{2}$  in head, lower jaw slightly shorter than upper; mouth cleft extends  $\frac{1}{4}$  to  $\frac{3}{8}$  to eye; maxillary barbel reaches middle of depressed anal to  $\frac{1}{4}$  in adipose fin length, outer mental barbel  $\frac{1}{4}$  in depressed pectoral fin, inner mental barbel  $\frac{1}{4}$  to pectoral origin; moderate band of villiform teeth in upper jaw and little narrower crescentic band below; interorbital width  $5\frac{1}{4}$  to  $5\frac{1}{2}$  in head, low, depressed; frontal fontanel begins slightly behind posterior internarial width and extends back to base of occipital extension, which reaches dorsal plate. Gill opening extends forward opposite front eye edge. Gill rakers 2+6, lanceolate,  $\frac{3}{4}$  of gill filaments, which are  $3\frac{1}{2}$  in eye.

Skin smooth. Occipital bones largely smooth. Humeral extension attenuated, length  $2\frac{1}{10}$  in depressed pectoral fin. Lateral line complete, distinct, axial along side of body.

D. I, 6, 1, spine  $1\frac{1}{4}$  to  $1\frac{2}{10}$  in head with both edges entire, first branched ray  $1\frac{1}{4}$  to  $1\frac{1}{2}$ ; adipose fin moderately high, length 3 to  $3\frac{1}{10}$  in fish without caudal; A. II, 8, 1, third branched ray  $1\frac{1}{4}$  to  $1\frac{1}{2}$ ; caudal 3 to  $3\frac{3}{8}$  in rest of fish, deeply forked; least depth of caudal peduncle 3 to  $3\frac{1}{4}$  in head; pectoral  $1\frac{1}{4}$  to  $1\frac{1}{2}$ , rays I, 9, spine with 8 antrorse serrae on outer half of edge terminally and inner edge with 17 rather large denticles on all but terminal fifth; ventral  $1\frac{1}{4}$  to  $1\frac{1}{2}$  in head, rays I, 5.

Color in alcohol brown, slightly paler on under surface of head, belly and tail. Eyes gray. Each barbel with dark brown narrow edge or line. Dark brown area on top of head each side of groove of fontanel. Dark brown to blackish lateral band from side of snout above base of maxillary barbel, through eye, over postocular and along each side of lateral line as bordering line its entire extent or to caudal base. First dorsal pale brown, each membrane gradually darker brown terminally. Other fins all uniformly pale or light brown.

FIGS. 12 TO 15.—*Pimelodella enochi* new species.FIGS. 16 TO 19.—*Pimelodella laurenti* new species.

A. N. S. P. no 69378. Açude Piloos, Parahyba, Brazil. October 14, 1936. Length 59 mm. Type.

A. N. S. P. no. 69379, same data, paratype. Length 56 mm.

Though I have no small or young examples the evidence seems to show the present species distinct from *Pimelodella gracilis* (Valenciennes). This would especially appear in the absence of the dark lateral band, clearly shown in the Eigenmann, McAtee, Ward photographic reproduction. Eigenmann later in 1917 says "The lateral band extends from snout to caudal." In *Pimelodella enochi* the dark lateral band is confined to the head and trunk. They all agree however in the length of the depressed dorsal  $1\frac{1}{4}$  to 2 in the adipose fin. My materials show the adipose fin length  $2\frac{1}{2}$  to  $2\frac{1}{2}$  in fish without caudal, while the photograph shows  $2\frac{1}{2}$ . The Jaguaribe specimen alone has the pectoral spines intact, showing their outer edges roughened and forming 6 or 7 low antrorse serrae terminally; hind or inner edge with 18 more erect denticles reaching only to terminal fourth of spine.

(For Dr. George F. Enoch, of Philadelphia, to whom I am indebted for various local fishes.)

***Pimelodella laurenti*** new species

Figures 16 (head above), 17 (lateral view), 18 (pectoral fin) and 19 (dental plates).

Depth  $4\frac{1}{2}$  to  $4\frac{3}{4}$ ; head  $3\frac{1}{2}$  to  $4\frac{1}{10}$ , width  $1\frac{1}{2}$  to  $1\frac{3}{4}$ . Snout (in profile)  $2\frac{3}{4}$  to  $2\frac{3}{4}$  in head; eye  $3\frac{1}{4}$  to 4,  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in snout, greater than bony interorbital, only upper edge or border of eye free, lower edge adnate with surrounding tissues; mouth width  $2\frac{1}{2}$  to  $2\frac{9}{10}$  in head, lower jaw slightly shorter or included in upper when closed; mouth cleft reaches nearly back to hind basal end of adipose fin, outer mental barbel reaches  $\frac{2}{3}$  in depressed pectoral, inner mental barbel  $\frac{1}{2}$  in depressed pectoral; moderate band of very fine villiform teeth in each jaw, upper dental plate little broader, and lower crescentic; interorbital width  $7\frac{1}{2}$  in head, low, slightly convex; frontal fontanel begins little before posterior internarial space and extends back to base of occipital extension which reaches dorsal plate completing bony dorsal bridge. Gill opening extends forward about first third in eye. Gill rakers 2+7, lanceolate,  $\frac{1}{4}$  of gill filaments, which are 2 in eye.

Skin smooth. Top of head covered with thin smooth skin, not striate. Humeral extension attenuated, length  $1\frac{1}{2}$  in depressed pectoral fin. Lateral line complete, distinct, axial along side of body.

D. I, 6, 1, spine  $1\frac{1}{2}$  to  $1\frac{1}{2}$  in head, front edge with 9 obsolete or weak antrorse serrae on its terminal half and hind edge entire; adipose fin  $2\frac{3}{4}$  in fish without caudal; A. v, 8, 1, second branched ray  $1\frac{1}{2}$  in head; caudal  $3\frac{1}{2}$  in rest of fish, deeply forked; least depth of caudal peduncle  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in head; pectoral  $1\frac{1}{2}$ , rays I, 8, spine with outer edge finely or minutely serrate on basal half followed by 7 low antrorse serrae terminally and hind edge with 12 denticles on basal  $\frac{2}{3}$ ; ventral  $1\frac{1}{2}$  to  $1\frac{1}{2}$  in head, rays I, 5.

Color in alcohol largely uniform brown, slightly paler on under surface of head and belly. On top of head each side of frontal fontanel and behind

eyes dark area. Iris dark gray. Grayish suffusion above humeral extension. Each barbel with dark brown edge or marginal line. Dark brown lateral band on side of snout, postocular and back along each side of lateral line to caudal base.

A. N. S. P. no. 19380. Jatobá, Rio São Francisco, Pernambuco. October 14, 1936. Length 89 mm. Type.

A. N. S. P. nos. 19381 to 19382, same data, paratypes. Length 79 to 85 mm.

Closely related to *Pimelodella enochi* but differing in proportions, especially its deeper body, different pectoral armature and broader dark lateral band.

(For Mr. Philip Laurent of Philadelphia, long associated in the entomological department of the Academy.)

***Pimelodella witmeri* new species**

Figures 20 (head above), 21 (lateral view), and 22 (dental plates).

Depth 5 to  $5\frac{2}{3}$ ; head 4 to  $4\frac{1}{2}$ , width  $1\frac{2}{3}$  to  $1\frac{3}{4}$ . Snout (in profile)  $2\frac{3}{4}$  in head; eye  $3\frac{1}{4}$  to 4,  $1\frac{3}{4}$  to  $1\frac{1}{2}$  in snout, 1 to  $1\frac{1}{4}$  in interorbital, lids free all around; mouth width  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in head, lower jaw shorter or included in upper jaw when closed; mouth cleft extends  $\frac{1}{2}$  to eye; maxillary barbel reaches  $\frac{1}{2}$  to  $\frac{3}{4}$  in adipose fin, outer mental barbel to hind end of humeral extension, inner mental barbel to pectoral origin; lips rather broadly papillate; moderate band of villiform teeth in upper jaw and narrower crescentic band below; interorbital width  $3\frac{1}{4}$  to  $3\frac{3}{4}$  in head, low, depressed; frontal fontanel begins in posterior internarial width, narrow and extends to base of occipital extension which reaches dorsal plate completing bony predorsal bridge. Gill opening extends forward opposite front eye edge. Gill rakers 4+7, lanceolate, equal gill filaments, which are  $1\frac{1}{2}$  in eye.

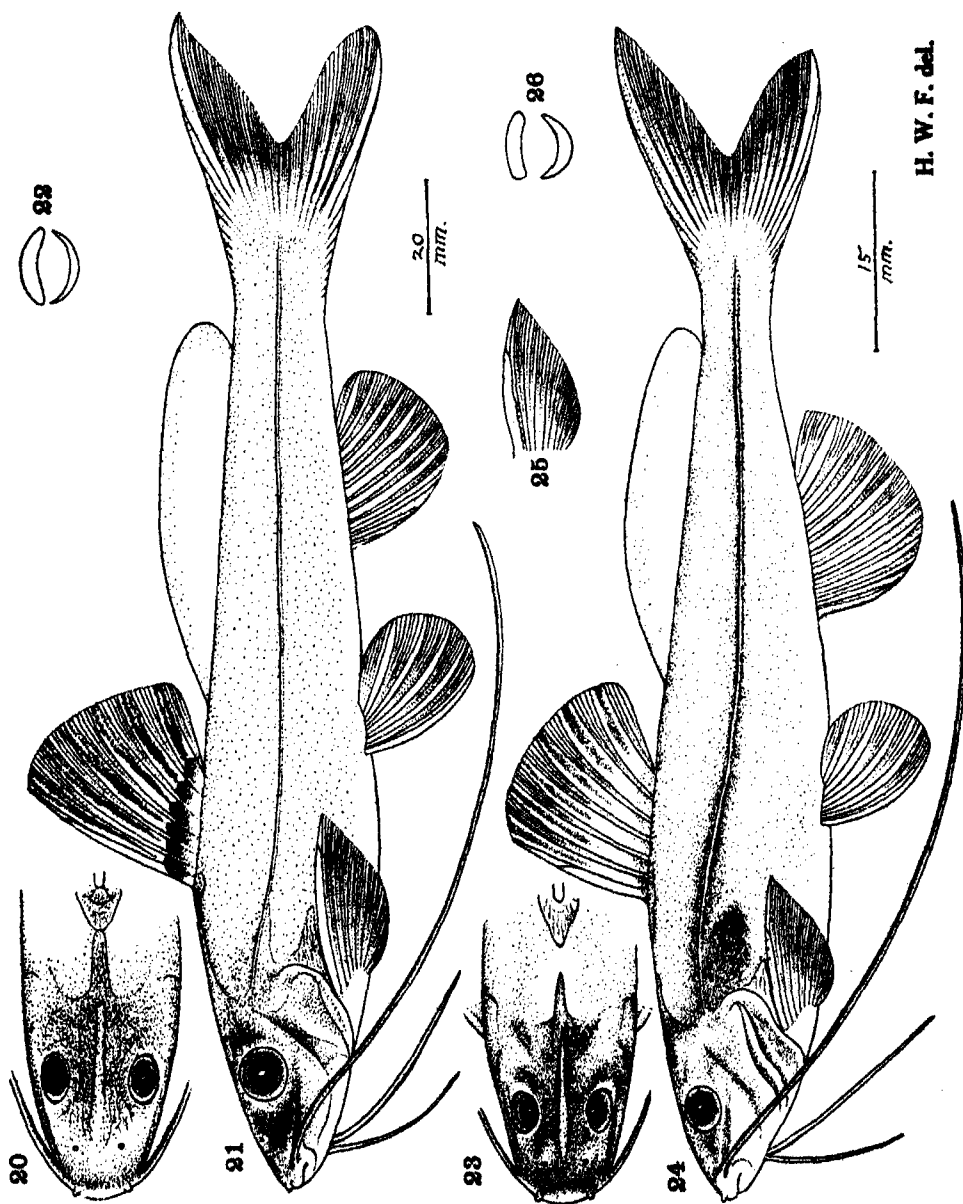
Skin smooth. Occipital bones and top of head covered with thin skin and more or less feebly striate. Humeral extension moderate,  $2\frac{1}{2}$  in depressed pectoral. Lateral line complete, distinct, axial along side of body.

D. I, 6, first branched ray  $1\frac{1}{2}$  to  $1\frac{1}{4}$  in head, spine with edges entire; adipose fin long, length  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in fish without caudal; A. III, 9, 1, second branched ray  $1\frac{1}{2}$  in head; caudal  $4\frac{1}{2}$  to  $5\frac{1}{16}$  in rest of fish, deeply forked and upper lobe little longer; least depth of caudal peduncle  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in head; pectoral  $1\frac{1}{2}$  to  $1\frac{1}{4}$ , spine (broken) and basal remaining section with entire edges, rays I, 8; ventral rays I, 5, fin  $1\frac{1}{2}$  to  $1\frac{1}{4}$  in head.

Color in alcohol grayish brown, much paler to whitish on under surface of head, abdomen and tail. Iris gray. Lips pale or whitish all around. Maxillary barbel with narrow dark edge above, and each of mental barbels with brown longitudinal line. Dorsal with dark gray basal band and each membrane more or less gray terminally. Adipose fin and caudal brownish, latter little darker terminally. Other fins pale to whitish.

A. N. S. P. no. 69383. Rio Jaguaribe, Orós, Ceará. June 25, 1937. Length 168 mm. Type.

Also A. N. S. P. nos. 69384 to 69385, same data, paratypes. Length 101 to 165 mm.

FIGS. 20 to 22.—*Pimelodella witmeri* new species.FIGS. 23 to 26.—*Rhamdella robinsoni* new species.

Known by its long adipose fin, absence of dark lateral band, small caudal and rather large eye. The details of its fin armature are not known as the fin spines have all been broken off.

(For Mr. J. S. Witmer to whom I am indebted for Pennsylvania fishes.)

**Rhamdella robinsoni** new species "Mandy Chorão." Figures 23 (head above), 24 (lateral view), 25 (pectoral fin) and 26 (dental plates).

Depth  $5\frac{1}{2}$ ; head  $3\frac{1}{2}$ , width  $1\frac{1}{2}$ . Snout (in profile)  $2\frac{1}{2}$  in head; eye  $4\frac{1}{2}$ ,  $1\frac{1}{2}$  in snout,  $1\frac{1}{10}$  in interorbital, lids free all around; mouth width  $2\frac{1}{2}$  in head, lower jaw slightly shorter than upper and included in closed mouth; mouth cleft extends  $\frac{1}{2}$  to eye; maxillary barbel reaches  $\frac{3}{4}$  in adipose fin, outer mental barbel  $\frac{2}{3}$  in depressed pectoral fin, inner mental barbel to pectoral base; teeth finely villiform, in a moderately broad band above, and a little narrower crescentic band below; interorbital width  $4\frac{1}{2}$  in head, low, depressed, flattened; frontal fontanel begins in middle of posterior internarial width, narrow, reaches base of occipital extension, which last extends only  $\frac{1}{2}$  to dorsal plate and leaves a slightly incomplete bony bridge. Gill opening extends forward opposite front eye edge. Gill rakers  $3+6$ , lanceolate,  $1\frac{1}{2}$  in gill filaments, which are  $1\frac{1}{2}$  in eye.

Skin smooth. Occipital bones smooth, covered with thin skin. Humeral extension  $2\frac{1}{2}$  in depressed pectoral fin. Lateral line complete, distinct, axial along side of body to caudal base.

D. I, 6, spine  $2\frac{1}{10}$  in head and with entire edges, first branched ray  $1\frac{1}{2}$ ; adipose fin  $2\frac{1}{2}$  in fish without caudal; A. v, 7, 1, first branched ray  $1\frac{1}{2}$ ; caudal  $3\frac{1}{2}$  in rest of fish, deeply forked, lower lobe shorter; least depth of caudal peduncle  $3\frac{1}{10}$  in head; pectoral  $1\frac{1}{2}$ , rays I, 8, spine with 3 low antrorse serrae on terminal fourth of front edge and 8 low denticles along basal half of hind edge; ventral rays I, 5, fin  $1\frac{1}{2}$  in head.

Color in alcohol uniform brown generally, scarcely paler below. Iris gray. Lips pale. Each barbel with dark bordering line above. Dorsal pale brown, each membrane slightly darker terminally. Other fins all uniformly pale. Gray suffusion above pectoral and behind gill opening. Lateral line embraced anteriorly with little darker brown narrowed area.

A. N. S. P. no. 69386. São José do Egito, Pernambuco. October 14, 1936. Length 97 mm. Type.

A species characterized by its rather slender tail, dark lateral band from head along lateral line narrowing and inconspicuous beyond front of adipose fin, the short dorsal spine  $2\frac{1}{10}$  in head, the frontal fontanel reaching the base of the occipital extension, maxillary barbel reaching little beyond middle of the adipose fin, which is  $2\frac{1}{2}$  in fish without the caudal.

(For the late Dr. George S. Robinson of Philadelphia, to whom I am indebted for many local fishes.)

**Rhamdella papariae** new species "Mandy." Figures 27 (head above), 28 (lateral view), 29 (pectoral fin) and 30 (dental plates).

Depth  $5\frac{1}{2}$ ; head  $4\frac{1}{2}$ , width  $1\frac{1}{2}$ . Snout  $2\frac{1}{2}$  in head; eye  $4\frac{1}{2}$ , 2 in snout, equals bony interorbital, with free margin all around; mouth width  $2\frac{1}{2}$  in



head; mouth cleft reaches barely  $\frac{1}{4}$  to eye, lower jaw much shorter and included in closed upper; maxillary barbel reaches  $\frac{3}{4}$  in adipose fin, outer mental barbel reaches half way in depressed pectoral fin, inner mental barbel reaches  $\frac{1}{4}$  to pectoral origin; lips rather narrow and lower with only short lateral sulcus, leaving median symphyseal entire region about  $\frac{3}{4}$  extent of mouth width; teeth villiform, simple, fine, in rather narrow uniform and similar bands in jaws without backward extensions; bony interorbital width  $3\frac{3}{4}$  in head, low, depressed; frontal fontanel wide, extends back as far as base of occipital extension; narrow supraoccipital extension nearly reaching dorsal plate, only separated by very narrow interval, long as snout, width  $3\frac{3}{4}$  in its length. Gill rakers  $3+8$ , pointed, 2 in gill filaments, which are  $1\frac{1}{2}$  in eye.

Skin smooth. Lateral line distinct, complete, axial along side of body and reaches middle of caudal base. Humeral extension smooth, little defined behind and extends  $\frac{1}{2}$  in depressed pectoral fin.

D. I, 6, entire pungent spine 2 in head, first branched ray  $1\frac{1}{2}$ ; adipose fin  $3\frac{1}{10}$  in fish without caudal; A. iv, 7, 1, first ray 2 in head; least depth of caudal peduncle  $2\frac{3}{4}$ ; caudal  $4\frac{1}{2}$  in rest of fish, deeply forked with slender pointed lobes; pectoral  $1\frac{1}{4}$ , spine rather narrow, pungent, with 15 low antrorse points along  $\frac{2}{3}$  of outer edge terminally, basally row of very fine small points, and 13 short low antrorse denticles along  $\frac{2}{3}$  of inner edge, rays I, 7; ventral rays I, 5, fin length  $1\frac{1}{2}$  in head. Vent midway in length of depressed ventrals.

Color in alcohol largely uniform dark brown, evidently the dark shades due largely to conditions of preservation. A dark or blackish line embraces lateral line its entire extent though not sharply defined. Iris and barbels brown, each of latter bordered above with dark line. Dorsal brown, each membrane bordered with gray between rays and basally fin paler or lighter. Caudal gray terminally on lobes. Lower fins all apparently were uniformly paler, like belly and under surfaces.

A. N. S. P. no. 69387. Lago Papary, Rio Grande do Norte, Brazil. October 14, 1936. Length 135 mm. Type.

Only the type obtained. This species is referred to *Rhamdella* as the occipital extension is not connected with the bony dorsal plate, thus leaving the bony predorsal bridge disconnected. The large eye, elevated cranium, long adipose fin and black lateral band are other features. From *Rhamdella robinsoni* it differs in its shorter humeral extension, different pectoral armature, shorter adipose fin and different coloration.

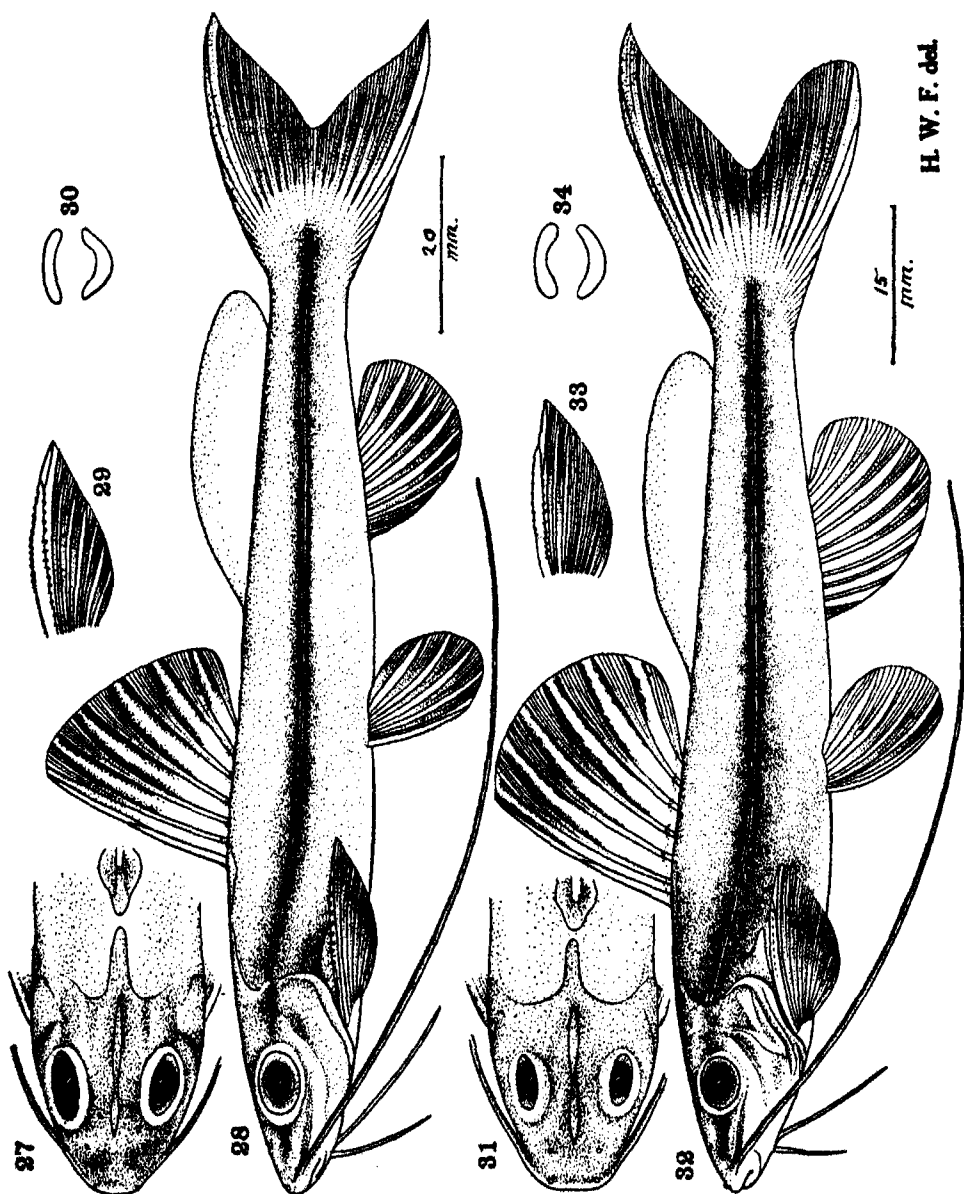
(Named for Lago Papary.)

*Rhamdella wolfe* new species

"Mandy."

Figures 31 (head above), 32 (lateral view), 33 (pectoral fin) and 34 (dental plates).

Depth  $5\frac{1}{2}$  to  $6\frac{1}{2}$ ; head  $3\frac{3}{4}$  to  $4\frac{1}{2}$ , width  $2\frac{3}{4}$  to  $1\frac{1}{2}$ . Snout (in profile)  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in head; eye  $4\frac{3}{4}$  to  $4\frac{1}{2}$ ,  $1\frac{1}{2}$  to  $1\frac{1}{4}$  in snout, 1 to  $1\frac{1}{2}$  in interorbital, edge free all around; mouth width  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in head; mouth cleft extends  $\frac{1}{2}$  to eye, lower little shorter than upper and included when closed; maxillary barbel



FIGS. 27 to 30.—*Rhamdella papariae* new species.  
 FIGS. 31 to 34.—*Rhamdella wolfi* new species.

reaches  $\frac{1}{2}$  to  $\frac{1}{3}$  in depressed anal, outer mental barbel reaches  $\frac{1}{2}$  in depressed pectoral, inner mental barbel reaches  $1\frac{1}{2}$  to 2 in space to pectoral origin; lips narrow, lower with sulcus leaving median symphyseal entire region  $\frac{1}{2}$  extent of mouth width; teeth villiform, simple, firm, in narrow bands in jaws without backward extensions; entire interorbital width 4 to  $4\frac{1}{2}$  in head, low, depressed, level; frontal fontanel rather narrow, extends back whole length of cranium to base of supraoccipital extension; narrow supraoccipital not articulating with dorsal plate, separated by very short interval, less than pupil diameter, width  $\frac{1}{2}$  its length. Gill rakers 3+7, lanceolate,  $\frac{1}{2}$  of gill filaments, which are  $1\frac{1}{2}$  in eye.

Skin smooth. Lateral line distinct, complete, axial, reaches middle of caudal basally. Humeral extension smooth, reaches  $2\frac{3}{4}$  in depressed pectoral. Top of head and predorsal region smooth.

D. I, 6, spine rather thin, entire and ends in long fleshy point equal to  $\frac{3}{4}$  of osseous portion, first ray  $1\frac{1}{2}$  to  $1\frac{1}{3}$  in head; adipose fin length  $2\frac{1}{2}$  to 3 in fish without caudal; caudal 3 to  $3\frac{1}{2}$ , deeply forked, lobes sharply pointed, and upper or lower lobe may be the longest; least depth of caudal peduncle  $2\frac{1}{2}$  to  $3\frac{1}{2}$  in head; A. v or vi, 7, second branched ray  $1\frac{1}{2}$  to  $1\frac{2}{3}$ ; pectoral  $1\frac{1}{2}$  to  $1\frac{1}{3}$ , compressed spine  $\frac{1}{2}$  length of fin, outer edge with 10 to 12 antrorse and rather low points along terminal half, and inner edge with 12 rather low or short denticles along basal  $\frac{3}{4}$  its extent, rays I, 9; ventral rays I, 5, fin  $1\frac{1}{2}$  to  $1\frac{1}{3}$  in head.

Color in alcohol largely uniform brownish, scarcely paler below. Iris grayish. Barbels brownish. Lateral line in a dark gray band, not wider than pupil, for its whole extent.

A. N. S. P. no. 69388. Rio Choró, Ceará. 1936. Length 116 mm. Type.

A. N. S. P. nos. 69389 to 69391, same data, paratypes. Length 89 to 96 mm.

Differs from *Rhamdella papariae* in the comparatively smaller eye, first dorsal encroaching on front part of the adipose fin, ventral scarcely reaching anal and the different pectoral armature.

(For the late Herman T. Wolf of Philadelphia, who made several interesting collections of American fishes for the Academy.)

**Pimelodus maculatus** Lacépède "Mandy amarelo."

*Pimelodus maculatus* Lacépède, Hist. Nat. Poiss., vol. 5, 1803, pp. 94, 107 (type locality, "le grand fleuve de la Plata, et il a été observé a Buenos-Ayres, ainsi qu'a la Encenada").—Fowler, Proc. Acad. Nat. Sci. Phila., 1915, p. 214 (type of *Pseudorhamdia piscatrix* Cope; Demarara; Surinam; Ambyiacu R.); vol. 91, 1939 (Feb. 20, 1940), p. 285 (reference).

*Pimelodus clarias* (not Linnaeus) Eigenmann, Mem. Carnegie Mus., vol. 5, June 1912, p. 72 (British Guiana).—Fowler, Proc. Acad. Nat. Sci. Phila., 1914, p. 263 (Rupununi R.); vol. 78, 1926, p. 265 (Buenos Aires); vol. 84, Aug. 18, 1932, p. 365 (Descalvados).

Three, 135 to 245 mm., Forteleza, Ceará. Also three smaller, 87 to 137 mm. Maxillary barbel may reach end of filament of upper caudal lobe. Dorsal spine with front edge entire and upper half of hind edge with antrorse serrae. Pectoral spine with obsolete or low serrae along basal edge of outer half; inner edge with strong antrorse serrae.

One, 140 mm., Jatobá, Rio São Francisco, Pernambuco. With 3 rows of large dark blotches on side.

Two, 80 to 84 mm., Ceará. Also with 3 rows of rather large dark lateral spots.

**Hemisorubim platyrhynchos** (Valenciennes)

*Platystoma platyrhynchos* Valenciennes, Hist. Nat. Poiss., vol. 15, 1840, p. (20) 27 (type locality, No locality; "Cabinet du Roi de celui de Lisbonne").

*Hemisorubim platyrhynchos* Eigenmann, Mem. Carnegie Mus., vol. 5, June 1912, p. 181 (Schomburgk specimen).—Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 224 (Contamana, Peru).

Three, 265 to 380 mm., Therezina, Piauhy.

**Pseudoplatystoma fasciatum** (Linnaeus) "Soruby."

*Silurus fasciatus* Linnaeus, Syst. Nat., ed. 12, pt. 1, 1766, p. 505 (type locality, Brazil; Surinam).

*Pseudoplatystoma fasciatum* Eigenmann, Mem. Carnegie Mus., vol. 5, June 1912, p. 182 (British Guiana).—Fowler, Proc. Acad. Nat. Sci. Phila., vol. 84, Aug. 18, 1932, p. 365, figs. (2 of variation) (Descalvados); vol. 91, 1939 (Feb. 20, 1940), p. 224 (Contamana, Peru).

One, 275 mm., Rio Parnahyba, Therezina, Piauhy. 1936.

**Sorubim lima** (Schneider) "Bico de Pato," "Sorubim."

*Silurus lima* Schneider, Syst. Ichth. Bloch, 1901, p. 384 (type locality, "flumine Maranham Brasiliae").

*Sorubim lima* Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 225 (Contamana, Peru).

Two, 258 to 310 mm., Rio Parnahyba, Therezina, Piauhy. 1936.

Four, 50 to 64 mm., Ilha Penedo, Jatobá, Pernambuco, Rio São Francisco.

## DORADIDAE

**Platydoras costatus** (Linnaeus)

*Silurus costatus* Linnaeus, Syst. Nat., ed. 10, pt. 1, 1758, p. 306 (type locality, "in Indiis" = South America).—Bonnaterre, Tabl. Ichth., 1788, p. 155, pl. 64, fig. 255 ("La mer des Indes").

*Doras costatus* Fowler, Proc. Acad. Nat. Sci. Phila., May 29, 1914, p. 263 (Rupununi R.); May 28, 1915, p. 220 (no data).

*Platydoras costatus* Eigenmann, Trans. Amer. Phil. Soc., new ser., vol. 22, pt. 5, 1925, p. 316, pl. 1, figs. 5 and 14, pl. 3, figs. 1 and 2, pl. 5, figs. 1 and 2, pl. 9, figs. 1 and 3 (Brazil; Bolivia; Guiana; Peru; Paraguay).

Three, 214 to 250 mm., Forteleza, Ceará. 1937.

**Hassar woodi** new species "Mandy pirá." Figures 35 (head above), 36 lateral view and 37 (head below).

Depth  $3\frac{1}{2}$ ; head 3, width  $1\frac{1}{2}$ . Snout (in profile)  $1\frac{1}{2}$  in head; eye  $5\frac{1}{2}$ ,  $3\frac{1}{2}$  in snout,  $1\frac{1}{2}$  in bony interorbital, eyelids adnate all around; mouth width  $4\frac{1}{2}$  in head, lower jaw much shorter and well included in upper when mouth closes; maxillary barbel reaches  $\frac{1}{2}$  in eye, with 9 filaments and joined by broad basal membrane with outer mental barbel which reaches  $1\frac{1}{2}$  to eye, and inner mental barbel but little shorter than outer; teeth very small, uni-

form, villiform, feeble, in small narrow band in front of upper jaw, broader band below; lips rather fleshy and like barbels basally papillate; bony interorbital  $3\frac{1}{2}$  in head, low, depressed, scarcely convex; frontal fontanel not extended behind eye; opercle smooth. Gill opening extends forward midway in eye. Gill rakers  $2+13$ , short fleshy points,  $\frac{1}{2}$  of gill filaments which are equal to eye.

Lateral line with  $9+22+2$  spinescent scutes, but without any points forward to suprascapula; each developed with strong spine forming keel. Interorbital from opposite front eye edge, occipital and predorsal bones striate; also broad humeral extension which reaches  $1\frac{1}{2}$  in depressed pectoral fin. Foramen of predorsal plate  $1\frac{1}{2}$  in interspace to its fellow.

D. I, 6, spine  $1\frac{1}{2}$  in head, front edge with 29 short denticles, small below and gradually larger terminally, and hind edge with 23 also directed upward; adipose fin long as eye; A. vi, 8, first branched ray  $2\frac{1}{2}$  in head; caudal  $1\frac{1}{2}$ , broad lobes pointed and fin well forked; least depth of caudal peduncle  $4\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ , rays I, 9, flat spine with 24 antrorse denticles along its outer edge to entire terminal sixth, 25 recurved denticles all along inner edge; ventral rays I, 6, fin  $2\frac{1}{10}$  in head.

Color in alcohol brown, paler to whitish below. Iris gray. Lips and mouth all pale like under surface. Fins all brownish, without black.

A. N. S. P. no. 69392. Rio Parnahyba, Therezina, Piauh. 1936. Length 240 mm. Type.

Only the type obtained. *Hassar affinis* (Steindachner)<sup>2</sup> is based on an example 255 mm. long, shows different proportions, different dorsal and pectoral armature, 3 scutes above the humeral expansion and scutes shown in lateral line  $10+19+2$ , the greatly larger eye  $1\frac{1}{2}$  in snout and exceeding the interorbital.

(For the late George Bacon Wood, of Philadelphia, who contributed many American fishes to the Academy's collection.)

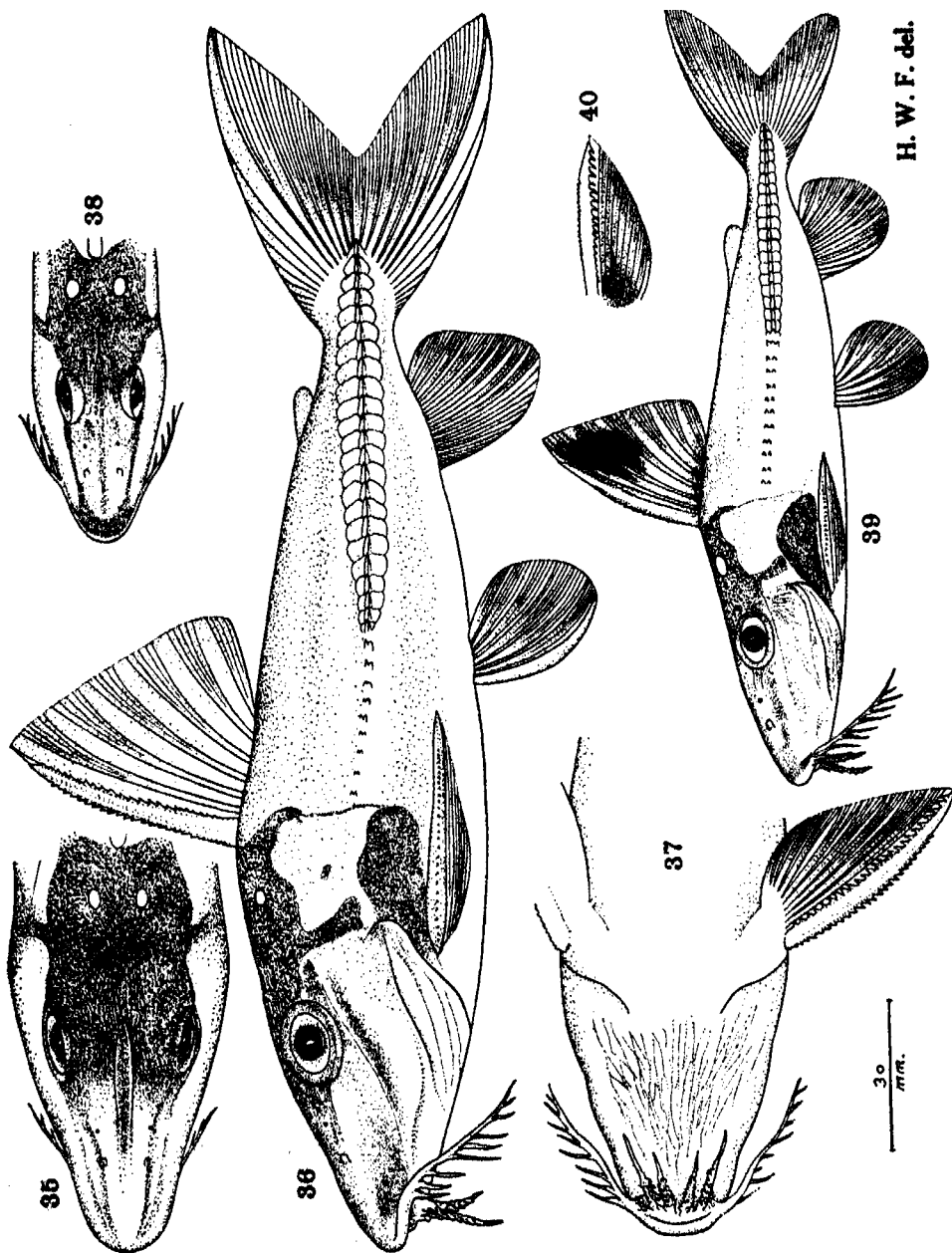
**Hassar iheringi** new species

Figures 38 (head above), 39 (lateral view) and 40 (pectoral spine).

Depth  $4\frac{1}{2}$  to  $4\frac{1}{2}$ ; head 3 to  $3\frac{1}{2}$ , width  $1\frac{1}{2}$  to 2. Snout (in profile)  $1\frac{1}{2}$  to 2 in head; eye  $3\frac{1}{2}$  to  $4\frac{1}{2}$ , 2 to  $2\frac{1}{2}$  in snout, greater than interorbital, eye margin adnate all around; mouth width  $5\frac{1}{2}$  to  $7\frac{1}{2}$  in head, lower jaw much shorter and well included in upper jaw when closed; maxillary barbel reaches eye or to its hind edge, with 6 to 10 tentacles or filaments, outer mental barbel nearly or quite reaches  $\frac{1}{2}$  to eye and inner mental barbel but slightly shorter; teeth very small, villiform points, only in very small narrow band above and small patch each side of mandibular symphysis below; lips fleshy, well papillate, also on most all of mental barbels; bony interorbital narrow, width  $5\frac{1}{2}$  to  $6\frac{1}{2}$ , low, depressed; frontal fontanel extends back well behind eye variably to nearly half an eye diameter; opercle with obsolete or feeble striae. Gill opening extends forward midway in eye. Gill rakers  $2+14$ , lanceolate, compressed, short points 3 in gill filaments, which are  $1\frac{1}{2}$  in eye.

Lateral line with  $11+18$  or  $19+1$  or 2 scutes, and begins behind humeral extension, first scutes mostly bicuspid, behind ventrals each develops strong

<sup>2</sup> *Ozydoras affinis* Steindachner, Denks. Akad. Wiss. Wien, vol. 43, 1882, p. 107, pl. 1, figs. 1-1a (type locality, Rio Puty).



FIGS. 35 to 37.—*Hassar woodi* new species.  
 FIGS. 38 to 40.—*Hassar iheringi* new species.

median spine directed back. From middle of interorbital posteriorly occipital and predorsal bones finely striate, more rugose on postocular region, also on broad humeral extension which reaches  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in depressed pectoral fin. Foramen of predorsal plate  $1\frac{1}{2}$  in interspace to its fellow.

D. I, 6, spine  $1\frac{1}{2}$  in head, front edge with 22 sharp denticles directed upward  $\frac{2}{3}$  its extent, and on terminal half of hind edge 16 antrorse short denticles; adipose fin equals eye or orbit; A. III or IV, 8 or 9, second branched ray  $2\frac{1}{2}$  to 3 in head; caudal  $1\frac{1}{2}$  to  $1\frac{3}{4}$ , upper lobe usually little longer; least depth of caudal peduncle 4 to  $5\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$  to  $1\frac{3}{4}$ , rays I, 9, strong depressed spine with 15 low denticles directed up along medial part of front edge and 19 larger forwardly directed denticles on hind edge; ventral rays I, 6, inserted well behind dorsal base, fin  $1\frac{1}{2}$  to  $2\frac{1}{2}$  in head.

Color in alcohol with back and upper surfaces brown, sides and below whitish to grayish white, with shining and bright reflections. Iris gray. Barbels all pale to whitish, like under surface of head. Fins all pale or light brownish. Dorsal black apically above, or over terminal half of fin inclusive of first 3 membranes and branched rays, though the apical edge of fin white. Inner surface of pectoral dusky basally.

A. N. S. P. no. 69393. Rio Parnahyba, Therezina, Piahy. 1936. Length 165 mm. Type.

A. N. S. P. nos. 69394 to 69395, same data, paratypes. Length 140 to 172 mm.

A. N. S. P. no. 69396. Ceará. 1937. Length 90 mm. Paratype.

Compared with the related *Hassar orestis* (Steindachner)<sup>3</sup> that species is much more slender, Steindachner's figure showing the depth over 5 (Eigenmann 1925 gives  $5\frac{1}{2}$  to 6), the anterior scutes of the lateral line better developed or shown as  $4+26+2$ , predorsal foramina larger, snout longer and humeral extension a little shorter, and armature of dorsal plate different. His specimens are 50 to 196 mm. long.

*Hassar wilderi* Kindle<sup>4</sup> is also similar in general appearance. Though Eigenmann gives the distinctions for this species as "Dorsal with a black spot . . . on the first two rays, extending to their tip" he evidently misquotes "The dark area in Plate 29 [22 intended], Fig. 4 [2 intended] should be continued to the tip of the rays." This is not shown in Atkinson's figure, which he publishes. It really shows greatly different armature for both the pectoral and dorsal spines than in my examples of the present species and a far larger predorsal foramen.

(For the late Dr. Rodolpho von Ihering.)

<sup>3</sup> *Oxydoras orestis* (Agassiz) Steindachner, Sitzsb. Akad. Wiss. Wien, vol. 71, pt. 1, 1875, p. 138, pl. 1 (type locality, "Rio Xingu, bei den Wasserfällen, und Rio Iça").

<sup>4</sup> Ann. N. Y. Acad. Sci., vol. 7, 1894, p. 251 (type locality, Trocenas on Rio Tocantins).—Eigenmann, Trans. Amer. Phil. Soc., new ser., vol. 22, pt. 5, 1925, pl. 22, fig. 2 (type).

## AUCHENIPTERIDAE

**Trachycorystes galeatus** (Linnaeus) "Cangati."

*Silurus galeatus* (Linnaeus, Syst. Nat., ed. 12, pt. 1, 1766, p. 503 (type locality, "in America australi").—Bonnaterre, Tabl. Ichth., 1788, p. 152, pl. 62, fig. 248 ("Amerique meridionale").

*Trachycorystes galeatus* Eigenmann, Mem. Carnegie Mus., vol. 5, June 1912, p. 198 (British Guiana).—Fowler, Proc. Acad. Nat. Sci. Phila., May 29, 1914, p. 266 (Rupununi R.); May 28, 1915, p. 222 (Surinam); Dec. 8, 1915, p. 529 (reference).

Two, 158 to 187 mm., Lago Papary, Rio Grande do Norte. They agree in every way with the colored figure published by Regan as *Pseudauchenipterus guppyi*. The fontanel is narrow and extends from level with the front eye edge back about 2 diameters. The dark markings on the body are, however, all more or less subdued or obscured.

One, 235 mm., Guaramiranga, Ceará.

One, 90 mm., Piancó, Parahyba. Greatly like Lütken's figure of *Auchenipterus lacustris* Reinhardt, though the top of the head is covered with smooth skin. In my specimen the markings are all blackish blotches and the general color of the fish dark brown.

One, 220 mm., Forteleza, Ceará. Very dark or gray-black above and soiled or blackish brown below.

**Auchenipterus nuchalis** (Agassiz) "Olho de gato."

*Hypophthalmus nuchalis* (Spix) Agassiz, Select. Gener. Pisc. Brasil., 1829, p. 17, pl. 17 (type locality, "Habitat in Brasilia aequatoriali").

*Auchenipterus nuchalis* Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 231 (Contamana, Peru).

Four, 112 to 145 mm., Rio Parnahyba, Therezina, Piahy. 1936. Depth  $4\frac{1}{2}$  to 5.

**Ageneiosus dentatus** Kner

*Ageneiosus dentatus* Kner, Sitzsb. Akad. Wiss. Wien, vol. 25, 1857, p. 441 (type locality, Surinam).—Eigenmann and Eigenmann, Occas. Pap. Cal. Acad. Sci., no. 1, 1890, p. 307, fig. 56 (outline dentition) (Teffé; Para; Cameta).

*Ageneiosus pardalis* Steindachner, Denks. Akad. Wiss. Wien, vol. 39, 1879, p. 33, pl. 3, figs. 1-1a (Magdalena R.; Venezuela; La Plata).

Depth 5; head  $3\frac{3}{4}$ , width  $1\frac{3}{4}$ . Snout (in profile)  $2\frac{1}{4}$  in head; eye  $6\frac{3}{4}$ , 3 in snout,  $3\frac{3}{4}$  in interorbital; maxillary not quite to eye, length  $2\frac{3}{4}$  in head; maxillary barbel concealed,  $2\frac{1}{4}$  in eye and hind end not reaching opposite rictus; mouth broad, with lower jaw shorter; teeth in broad villiform bands in jaw, about 16 transversely in front of each jaw; interorbital broad, convex; long slender frontal fontanel reaches base of occipital extension, narrowing posteriorly and bony bridge complete to dorsal fin.

Lateral line complete, zig zag, the junctures with branchlets. Head covered with thin skin above.

D. I, 6, broken spine at least half fin height with front edge entire, fin height 2 in head; adipose fin length  $4\frac{1}{2}$ ; A. III, 38?, front fin height  $3\frac{3}{4}$  in



head; lower caudal lobe  $1\frac{1}{2}$ , fin well emarginate; least depth of caudal peduncle  $2\frac{3}{4}$ ; pectoral  $1\frac{3}{4}$ , rays I, 13, slender spine entire; ventral  $1\frac{2}{3}$ , rays I, 6.

General color in alcohol dark gray above, sides and under surfaces whitish. Eye gray. Fins all brown.

One, 308 mm., Forteleza, Ceará.

**Ageneiosus valenciennesi** Bleeker

*Ageneiosus valenciennesi* Bleeker, Nat. Verh. Holland. Maatsch. Wet., Haarlem, ser. 2, vol. 20, 1864, p. 82 (on Valenciennes).—Eigenmann and Eigenmann, Occas. Pap. Cal. Acad. Sci., no. 1, 1890, p. 304, text fig. 54 (dentition) (R. Puty; Orestes St. John).

*Ageneiosus militaris* (not *Silurus militaris* Linnaeus) Valenciennes, Voy. Amer. Merid. d'Orbigny, vol. 5, pt. 2, Poiss., 1847, p. 7 (no locality).

*Ageneiosus militaris* Valenciennes, op. cit., pl. 4, fig. 1.

Two, 306 to 310 mm., Forteleza, Ceará.

**Ageneiosus brevifilis** Valenciennes "Mandubé."

*Ageneiosus brevifilis* Valenciennes, Hist. Nat. Poiss., vol. 15, 1840, p. (180) 242 (type locality, Cayenne).—Eigenmann and Eigenmann, Occas. Pap. Cal. Acad. Sci., no. 1, 1890, p. 309, text fig. 57 (dentition) (Serpa; Villa Bella).—Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 286 (reference).

*Pseudogeneiosus brevifilis* Bleeker, Nat. Verh. Holland. Maatsch. Wet. Haarlem, ser. 2, vol. 20, 1864, pl. 16, fig. 2 (Surinam).

Depth  $4\frac{9}{10}$  to 5; head  $3\frac{1}{2}$  to  $3\frac{3}{4}$ , width  $1\frac{1}{2}$  to  $1\frac{3}{4}$ . Snout (in profile) 2 in head; eye  $6\frac{1}{2}$  to 7,  $3\frac{1}{2}$  to  $3\frac{1}{2}$  in snout, 3 to 4 in interorbital; maxillary reaches close before eye, length 2 to  $2\frac{1}{2}$  in head; small maxillary barbel long as eye; teeth in rather broad coarsely villiform bands in jaws with about 15 teeth transversely in front of each jaw; interorbital  $1\frac{1}{2}$  to  $1\frac{1}{2}$  in head, convexly elevated; frontal fontanel extends back nearly opposite level of hind eye edges. Gill rakers 5+17, short points,  $\frac{1}{2}$  of gill filaments, which are  $\frac{1}{2}$  of eye.

Lateral line complete, very zig zag or waved throughout its course to caudal base. Head covered all over with smooth skin.

D. I, 6, compressed slender spine entire on both edges,  $1\frac{1}{2}$  to  $1\frac{2}{3}$  in head; adipose fin 3; A. III, 30 to III, 32, fin height 3 to  $3\frac{1}{2}$ ; caudal truncate to convex behind, length  $1\frac{1}{2}$  to 2; pectoral  $1\frac{1}{2}$  to  $1\frac{3}{4}$ , slender spine smooth, rays I, 14; ventral rays I, 6, fin  $2\frac{1}{2}$  in head.

Color in alcohol brown, little paler below. Sometimes some dark cloudings on back. Large examples grayish to gray-brown above, with obscure pale band from above gill opening back and another from humeral region usually obliterated posteriorly. Edge of adipose fin usually pale. Fins all brownish.

Three, 340 to 373 mm., Rio Parnahyba, Therezina, Piahy. 1936.

**CALlichthyidae**

**Corydoras garbei** R. von Ihering "Tamoatás", "Corydora."

*Corydoras garbei* R. von Ihering, Rev. Mus. Paulista, São Paulo, vol. 8, Jan. 1, 1910, p. 382 (type locality, "Rio São Francisco, Est. da Bahia").—Ellis, Ann. Carnegie Mus., vol. 8, nos. 3-4, May 5, 1913, p. 409, pl. 28, fig. 2 (photograph) (Joazeiro; Lagoa Pereira; Barreiras).

Six, 48 to 57 mm., São José do Egito, Pernambuco.

## LORICARIIDAE

*Plecostomus plecostomus* (Linnaeus)

*Acipenser plecostomus* Linnaeus, Syst. Nat., ed. 10, pt. 1, 1758, p. 238 (type locality, Surinam).

*Loricaria plecostomus* Bonnaterre, Tabl. Ichth., 1788, p. 158, pl. 65, fig. 260 ("L'Amerique australe").

*Plecostomus plecostomus* Eigenmann and Eigenmann, Occas. Pap. Cal. Acad. Sci., no. 1, 1890, p. 406 (Silva; L. Saraco; Pará; Hyavary; Coary; R. Puty; Surinam).—Eigenmann, Mem. Carnegie Mus., vol. 5, June 1912, p. 223 (British Guiana).—Fowler, Proc. Acad. Nat. Sci. Phila., April 1915, p. 233 (Surinam).

I have only the older Academy materials representing the present species, Dr. von Ihering having sent the subspecies described below.

*Plecostomus plecostomus papariae* new subspecies "Casudo." Figures 41 (head above), 42 (lateral view) and 43 (head below).

Depth  $4\frac{1}{2}$  to  $4\frac{3}{4}$ ; head  $3\frac{1}{2}$  to 4, length  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in its width. Snout (in profile)  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in head; eye  $4\frac{1}{2}$  to 5,  $3\frac{1}{2}$  to  $3\frac{3}{4}$  in snout,  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in interorbital; mouth width 2 to  $2\frac{1}{2}$  in head; buccal disk width subequal with interorbital, with broad papillate lower lips and upper also papillate; each side of lower buccal disk short cirrus slightly shorter than pupil; 22 slender curved teeth each side of upper jaw and 25 similar ones each side below; interorbital  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in head, depressed. Gill opening small, twice eye diameter, with lower part below eye.

Scutes 23 or  $24+2$  in lateral series; 6 transversely between dorsal and ventral origin, 3 predorsal. Scutes without keels or ridges, or spines. Scales on chest small, in short narrow transverse median area, with short extension each side from before gill opening. Very small scales form cuboid area over fore part of belly with narrow median constricted band posteriorly. Occipital extension forms rather short broad point.

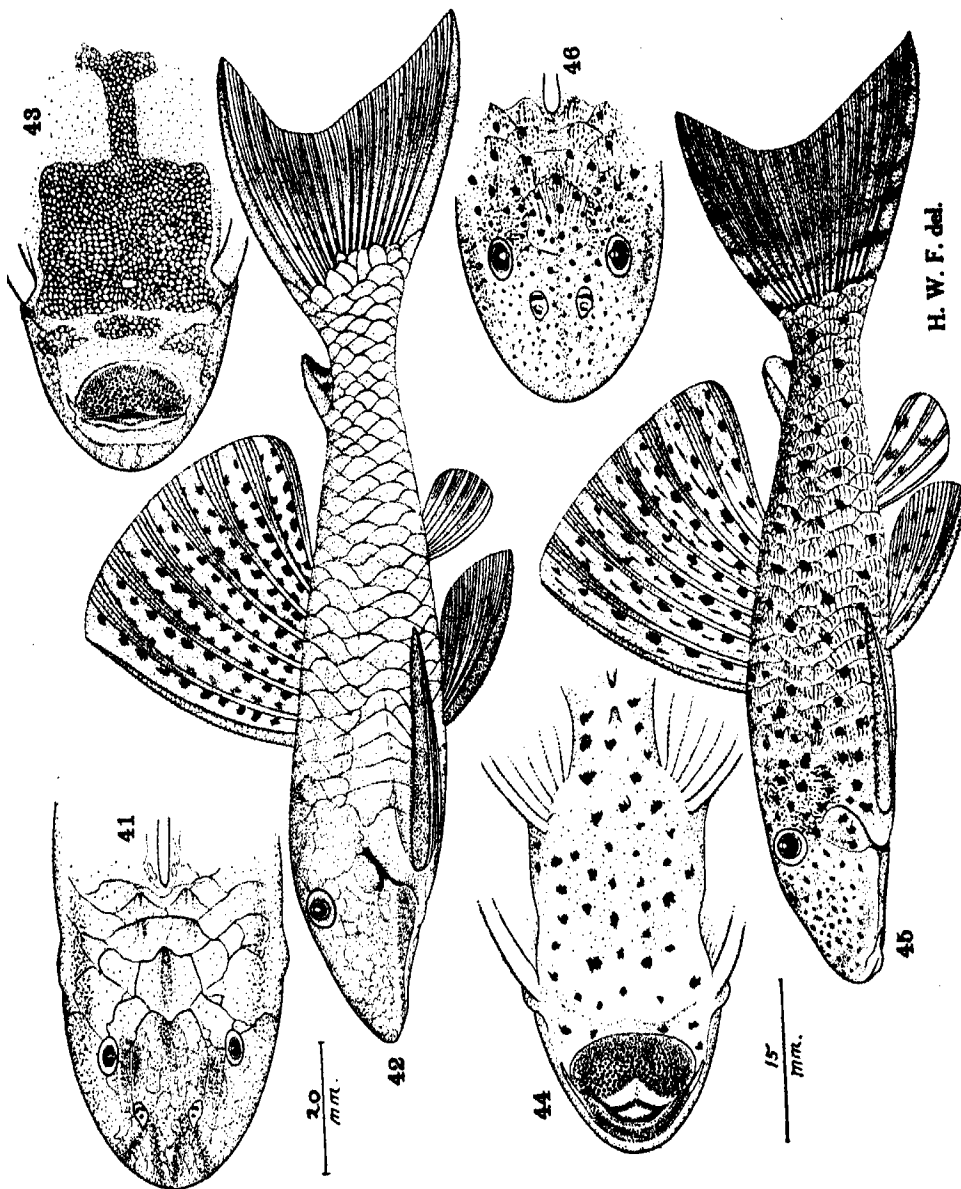
D. I, 7, spine  $1+\frac{1}{2}$  times head, terminally flexible; adipose fin  $2\frac{1}{2}$  in head, with large spine; A. I, 4, first branched ray 2 to  $2\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{2}$  to 3; caudal  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in rest of fish, emarginate chiefly above and upper lobe shorter; pectoral  $2\frac{1}{2}$  to 3, rays I, 6; ventral I, 5, fin equals head.

Color in alcohol dark umber, but little paler on under surface of head and belly. Iris dark gray-brown. Fins all more or less dark, or membranes dark to dusty gray. Dorsal with 2 rows of black spots on each membrane and each row close or next to fin ray, with row immediately before fin ray darker or black. Two dark spots on adipose fin. Three suffused dark bands on anal. Caudal with 6 obscure transverse dark bands. Pectoral with 7 black spots in row on outermost membrane and only few on inner membranes. Ventral with black spots like those on pectoral.

A. N. S. P. no. 69398. Lago Papary, Rio Grande do Norte. 1936. Length 149 mm. Type.

A. N. S. P. no. 69399, same data, paratype. Length 144 mm.

A. N. S. P. nos. 69400 and 69401. Rio Choró, Ceará. 1916. Length 155 to 160 mm. Paratypes.



FIGS. 41 to 43.—*Plecostomus plecostomus paparyae* new subspecies.  
 FIGS. 44 to 46.—*Plecostomus nudiventris* new species.

These agree in many ways with my larger specimen of *Plecostomus plecostomus* from the Rupununi. Spots on each dorsal membrane 10 and in 2 distinct series in all 3 specimens. The Rupununi specimen shows more distinct or prominent rows of keels, each ending in a denticle behind, along the rows of scutes longitudinally. It has also far more scales between the ventrals where about 18 irregular rows of scutes, whereas in the Lago Papary specimens there is only a narrow median area with 6 rows, only comprising  $\frac{1}{3}$  width of interventral region.

Several species deserve comparative comment. *Plecostomus seminudus* Eigenmann and Eigenmann<sup>5</sup> is based on a single specimen without size given and surely very indifferently diagnosed, or hardly described; thus the scutes "a band between the pectorals, sides of the belly and a narrow band between the ventrals covered with the scutes" are difficult to visualize without a figure. Although placed as a synonym of *Plecostomus plecostomus* (Linnaeus) by Regan in 1904, who states "Lower surface of head and abdomen, in the adult, almost completely covered with small granular scales", this would imply *Plecostomus seminudus* to be the young. His statement under *Plecostomus plecostomus* "In the young, spots on the head and body larger and fewer, fins with 4+6 transverse bars" would not apply if my specimens described above are admitted as "young." Eigenmann and Eigenmann describe the under surface of *Plecostomus seminudus* as "plain", whereas in my specimens I find traces of numerous moderate-sized dark spots.

(For Lago Papary.)

***Plecostomus nudiventris*** new species      "Cascudo."      Figures 44 (head below)  
45 (lateral view) and  
46 (head above).

Depth  $4\frac{1}{2}$ ; head  $3\frac{1}{2}$ , length  $1\frac{1}{2}$  in its width. Snout (in profile)  $1\frac{1}{2}$  in head; eye  $4\frac{1}{2}$ ,  $3\frac{1}{2}$  in snout,  $2\frac{1}{2}$  in interorbital; mouth width  $2\frac{1}{2}$  in head; buccal disk width  $1\frac{1}{2}$ , greater than interorbital, with broad papillate lips, lower broader and with cirrus each side  $\frac{1}{2}$  of eye; 12 slender curved teeth above each side and 12 below each side; interorbital  $1\frac{1}{2}$  in head, depressed, nearly level. Gill opening small, largely below eye.

Scutes 23+2 in lateral series; 5 or 6 transversely between dorsal and ventral origins; 3 predorsal. Scutes in rows along side of back each with small terminal spine behind. All scutes rugose striate longitudinally. Entire chest and belly naked. Occipital extension forms broad obtuse point.

D. I, 7, long slender spine  $1+\frac{1}{2}$  times head and terminally flexible adipose fin  $2\frac{1}{2}$  in head, spine moderately large; A. I, 3, first branched ray  $1\frac{1}{2}$  in head; least depth of caudal peduncle  $2\frac{1}{2}$ ; caudal  $2\frac{1}{2}$  in rest of fish, emarginate chiefly above and upper lobe shorter; pectoral  $3\frac{1}{2}$ , rays I, 5, spine well roughened with asperities; ventral rays I, 5, fin equals head.

Color in alcohol brown, under surface of head and belly paler, latter with obscure scattered variable dark gray to blackish spots. Head above

<sup>5</sup> Proc. Cal. Acad. Sci., ser. 2, 1888, p. 169 (type locality, Brazil?).

with numerous small close-set blackish spots. Trunk and tail with large black and less numerous spots above and on sides. Fins all grayish or lighter than general body color above. The dorsal distinctively marked, each membrane with 4 to 6 black spots, with median broken brown line or streak longitudinally. Caudal with 7 transverse dark bands. Anal with 2 rows of dark spots. Paired fins with 3 to 5 rows of dark spots.

A. N. S. P. no. 69402. Rio Choró, Ceará, near Forteleza. 1936. Length 82 mm. Type.

Characterized by the total absence of scales or scutes on the belly. Each dorsal membrane with 5 or 6 black ocelli and in intervals brown median vertical line or streak parallel with fin rays. *Plecostomus brevis* Nichols\* is based on an example 74 mm. long, as measured to the caudal base. It has a similar short body, though a greatly longer dorsal and its coloration is described as having "small dark spots on the dorsal, pectoral and ventral fins; otherwise unmarked" and "base of dorsal equal to its distance from the tip of the adipose." Its chief resemblance would be in the "abdominal surfaces entirely without scales."

(*Nudus* naked + *venter* belly.)

***Plecostomus spilurus*** new species "Plecostomios." Figures 47 (head above), 48 (lateral view) and 49 (head below).

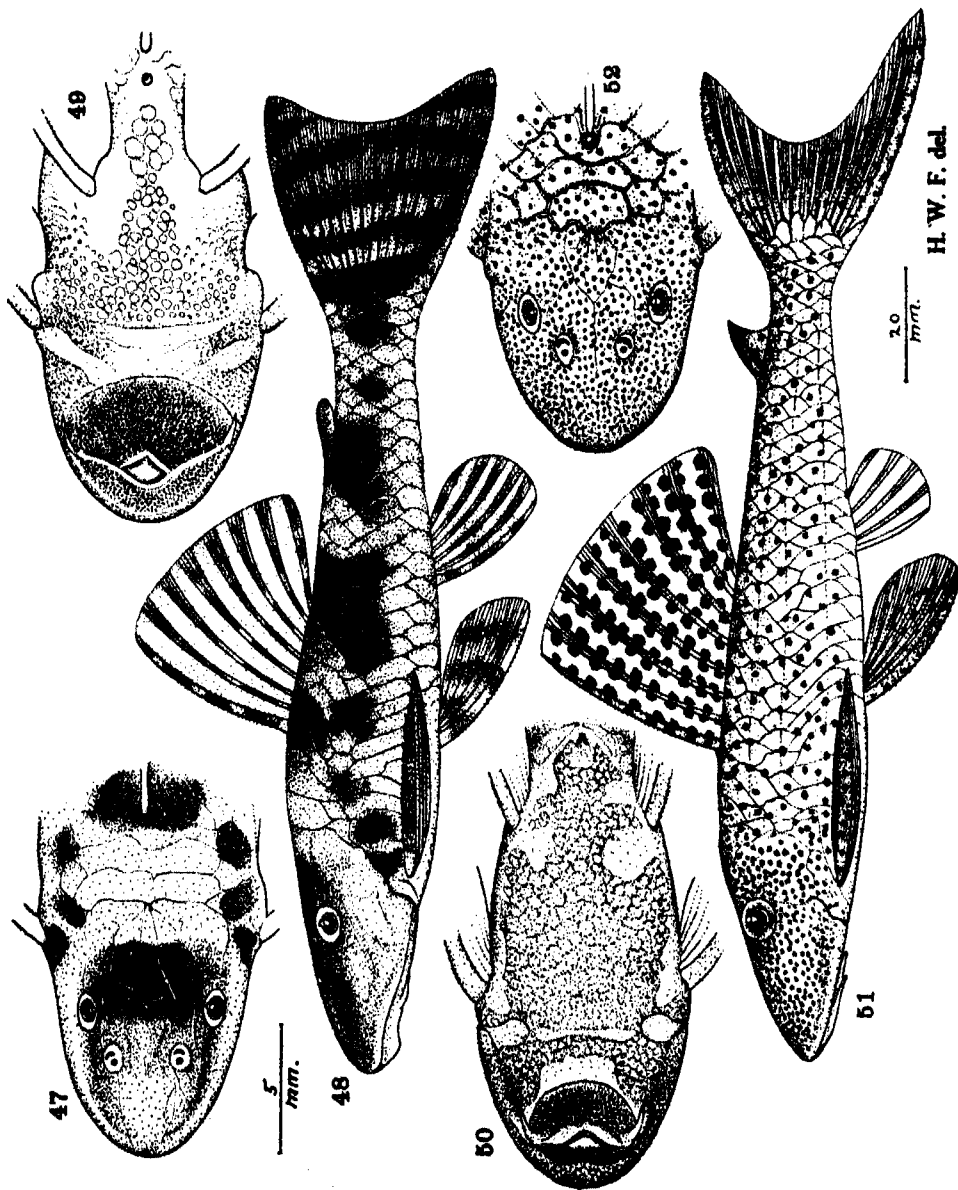
Depth 5 to 5½; head 3½ to 3¾, length 1½ in width to width 1½ in its length. Snout (in profile) 1¾ to 1¾ in head, eye 4½ to 5½, 2½ to 3½ in snout, 2 to 2¾ in interorbital; mouth width 2¾ in head; buccal disk width 1½ to 1¾, with very broad papillate lower lip, cirrus each side 1½ in eye; 8 or 9 short slender curved teeth each side above and 10 to 12 each side below; interorbital 1¾ to 2½ in head, low, but slightly convex. Gill opening small, largely behind eye.

Scales 23+2 in lateral series; 5 transversely between dorsal and ventral origins; 3 predorsal. Scutes without spines, but roughened and striate. Sides of head below and on thorax with granules. Belly medially and entirely across interpectoral region granular, though area restricted between ventrals and formed with larger scutes. Occipital obtuse, without extension.

D. I, 7, slender spine 1¼ to 1½ in head; adipose fin rudimentary, atrophied, without spine, often only slight vestigial ridge; A. I, 5, first branched ray 1½ to 2 in head; least depth of caudal peduncle 2½ to 2¾; caudal 3 to 3½ in rest of fish, emarginate behind, with upper lobe little shorter; pectoral 1 to 1½ in head, large spine spinescent, rays I, 6; ventral rays I, 5, fin 1½ to 1¾ in head.

Color in alcohol brown, under surfaces pale to whitish. Transversely on occiput dark band across head behind eyes. Obscure dark band on side of snout inclined up to eye. On body 3 large blackish saddles, first at front of dorsal, second at last dorsal rays and behind, and third at adipose fin. Fins all light brown, somewhat whitish to ochraceous. Dorsal with 3 or 4

\* Revista Mus. Paulista, São Paulo, vol. 11, 1919, p. 5 (type locality, "State of São Paulo").



FIGS. 47 to 49.—*Plecostomus spilurus* new species.  
 FIGS. 50 to 52.—*Plecostomus iheringi* new species.

dark blotches on spine and each ray. Caudal with 6 transverse dark bands, only 4 complete and of these basal one black, and bars resulting on ends of fin lobes also black. Anal with 3 suffused dark bars on each ray, likewise ventral. Pectoral with 3 to 6 dark or suffused blotches on spine and rays.

A.N.S.P. no. 69403. Rio Salgade, Icó, Ceara. 1937. Length 39 mm. Type.

A.N.S.P. nos. 69404 to 69408, same data, paratypes. Length 33 to 37 mm.

A small species like *Plectostomus spilosoma* and with very subdued or indistinct similar dark transverse bands. Only the caudal marked with a broad black transverse basal band, 2 or 3 gray bands and a terminal dark gray band.

(σπίλος blot + οἶρα tail; with reference to the dark marks on the caudal.)

*Plectostomus iheringi* new species

Figures 50 (head below), 51 lateral view) and 52 (head above).

Depth  $5\frac{1}{2}$ ; head 5, length  $1\frac{1}{2}$  in its width. Snout (in profile)  $1\frac{1}{2}$  in head; eye  $3\frac{1}{2}$ , 3 in snout,  $2\frac{1}{2}$  in interorbital; mouth width  $2\frac{3}{4}$  in head; buccal disk  $1\frac{1}{2}$ , width subequal with interorbital, with broad papillate lower lip, on each side slender cirrus  $\frac{4}{5}$  of eye; 18 short slender curved bifid teeth each side of upper jaw and 18 each side below; interorbital  $1\frac{1}{2}$  in head, low, depressed, each superciliary region little elevated. Gill opening small, mostly below eye.

Scutes  $27+2$  in lateral series; 4 transversely between dorsal and ventral origins; 3 predorsal. All scutes on body and head finely asperous, on body each with longitudinal rows of fine serrate keels with usually last spine of median series little enlarged and directed back; on body each row of scutes with obsolete longitudinal keel, that of lower side most pronounced. Few very small spines along subopercle and interopercle edge of gill opening. Occipital extension very short obtuse projection. Chest, breast and belly with extensive finely asperous area, rather broad on each side of head, and rather restricted medially in interventral region, with all scutes small and little defined.

D. I, 7, slender spine 4 in fish without caudal; adipose fin  $2\frac{1}{2}$  in head, spine rather robust; A. I, 4, first branched ray  $1\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{3}{4}$ ; caudal  $2\frac{3}{4}$  in rest of fish, emarginate, with lower lobe longer; pectoral  $3\frac{3}{4}$ , broad spine depressed with outer edge finely spinescent, rays I, 6; ventral rays I, 5, fin equals head.

Color in alcohol umber, little paler on under surface of head and belly. Head very finely and closely covered with small blackish brown spots, not extending along lower edge or under surface. Body above and on sides with larger scattered blackish brown spots, not extending below on under surface of belly or tail. Fins all pale or light. Each membrane of dorsal with 2 rows of dark spots, 5 to 10 in each series. Caudal covered with dark spots, also paired fins, but none on anal.

A. N. S. P. no. 69409. Ceará. 1937. Length 195 mm. Type.

Agrees largely with the lateral view of Steindachner's *Plecostomus tenuicauda*,<sup>7</sup> which is included as a synonym of *Plecostomus emarginatus* (Valenciennes) by Regan, likewise *Plecostomus villarsi* Lütken.<sup>8</sup> Both differ, as shown in Steindachner's figures of the dorsal view of their predorsal regions, in the projecting angle of the supraoccipital invading the first predorsal plate, and in *Plecostomus tenuicauda* by articulating with an additional plate on each side. In many other ways my specimen agrees with *Plecostomus villarsi*, especially in its long slender caudal peduncle, size and proportion of the dorsal fin, long lower caudal lobe and coloration. *P. villarsi* is said to be 480 mm. long and thus its comparatively smaller eye,  $3\frac{1}{2}$  in interorbital may be due to age. Its lower surface or belly is shown scaleless or naked over its hind  $\frac{3}{4}$ .

*Plecostomus lacerta* Nichols<sup>9</sup> is a slender species with depth 7. It is based on 3 specimens 55 to 70 mm. long to caudal base, and differs in having the "scutes behind supraoccipital irregular, about 5 in contact with it", the "lower surfaces scaleless", shorter caudal lobe with the fin only "slightly emarginate" and "pectorals barely reaching ventrals." Its color as given with "Dorsal, ventrals and anal more or less blackish towards their tips; caudal blackish, especially on the distal portion of the lower lobe; a somewhat circular colorless area in the center of the upper lobe", is at variance with the present species.

*Plecostomus ancistroides* R. von Ihering<sup>10</sup> is based on an example 210 mm., and is said to resemble *Plecostomus punctatus* (Valenciennes). That species as described by Regan in 1904 is with the "Lower surface of head and abdomen, in the adult, almost completely covered with small granular scales." For *Plecostomus ancistroides* von Ihering gives the ventral surface as all granular, except a line between the gill openings and a small area at the ventral bases. In specimens 70 mm. long the belly likewise granular, although also moderately smooth. Head with numerous small black spots, larger, somewhat distinct and compact on rest of body. Large dark spots size of eye on belly. Fin rays with large dark blotches, often forming transverse or variously undulate bars, especially over dorsal.

(For Dr. Rodolpho von Ihering.)

***Plecostomus jaguribensis* Fowler "Plecostomos."**

*Plecostomus jaguribensis* Fowler, Proc. Acad. Nat. Sci. Phila., May 28, 1915, p. 264, fig. 3 (type locality, Rio Jaguribe at Barro Alto, Brazil).

<sup>7</sup> Denks. Akad. Wiss. Wien, vol. 39, 1879, p. 40, pl. 6 (type locality, "Magdalenen-Stromes").

<sup>8</sup> Op. cit., p. 42, pl. 7 (type).

<sup>9</sup> Revista Mus. Paulista, São Paulo, vol. 11, 1919, p. 6 (type locality, "Poco Grande, State of São Paulo, Rio Juquia").

<sup>10</sup> Revista Mus. Paulista, São Paulo, vol. 8, 1911, p. 396 (type locality, "Rio Tatuhy, affluent do lado esquerdo do Rio Sorocaba; Rio Piracicaba, Est. do S. Paulo").



Three, 128 to 185 mm., Rio Jaguaribe, Orós, Ceará. 1937.

*Plecostomus lexi* R. von Ihering<sup>11</sup> is based on an example 460 mm. differing in the numerous white dots about size of pupil, over body and fins.

*Plecostomus variipictus* R. von Ihering<sup>12</sup> is founded on an example 370 mm. long with white lines on the dorsal membranes and other fins mostly with white spots forming transverse streaks.

***Plecostomus spilosoma* new species** "Plecostomos", "Casado." Figures 53 (head above), 54 (lateral view) and 55 (head below).

Depth  $5\frac{1}{4}$  to  $6\frac{3}{4}$ ; head  $3\frac{1}{4}$  to  $3\frac{3}{4}$ , long as wide. Snout (in profile)  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in head; eye  $3\frac{1}{2}$  to  $4\frac{1}{4}$ ,  $2\frac{1}{4}$  to  $2\frac{3}{4}$  in snout,  $1\frac{1}{4}$  to 2 in interorbital; mouth width  $2\frac{1}{4}$  to  $2\frac{1}{2}$  in head; buccal disk  $1\frac{1}{2}$  to  $1\frac{3}{4}$ , with broad papillate lower lip, on each side short cirrus long as pupil; 10 short slender curved bifid teeth each side above and 10 to 12 each side below; interorbital 2 to  $2\frac{1}{6}$  in head, low, depressed, level. Gill opening  $1\frac{3}{4}$  times eye, nearly entirely but close behind eye.

Scales 21 or  $22+2$  in lateral series; 4 transversely between dorsal and ventral origins; 3 predorsal. All scutes finely asperous, on body each with longitudinal rows of fine asperous striae; none of scutes forming any distinct keels or ridges longitudinally. Some rather coarse rugae on postocular, with naked longitudinal groove above humeral plate. Occipital extension very short point protruding into first predorsal scute but slightly. Except asperous band across interpectoral region below, triangular area each side of head below, and irregular narrow variable median area on belly extending back to vent, lower surface smooth. Each side of belly some irregular scattered asperous plates.

D. I, 7, slender spine nearly smooth and  $1\frac{1}{4}$  in head; adipose fin 3; A. I, 5, first branched ray  $1\frac{1}{4}$ ; least depth of caudal peduncle  $2\frac{1}{4}$  to 3; caudal  $3\frac{1}{4}$  to  $3\frac{3}{4}$  in rest of fish, emarginate, with lower lobe little longer; pectoral rays I, 6, spine depressed, large outer edge especially terminally spinescent, length 1 in head; ventral  $1\frac{1}{4}$ , rays I, 5.

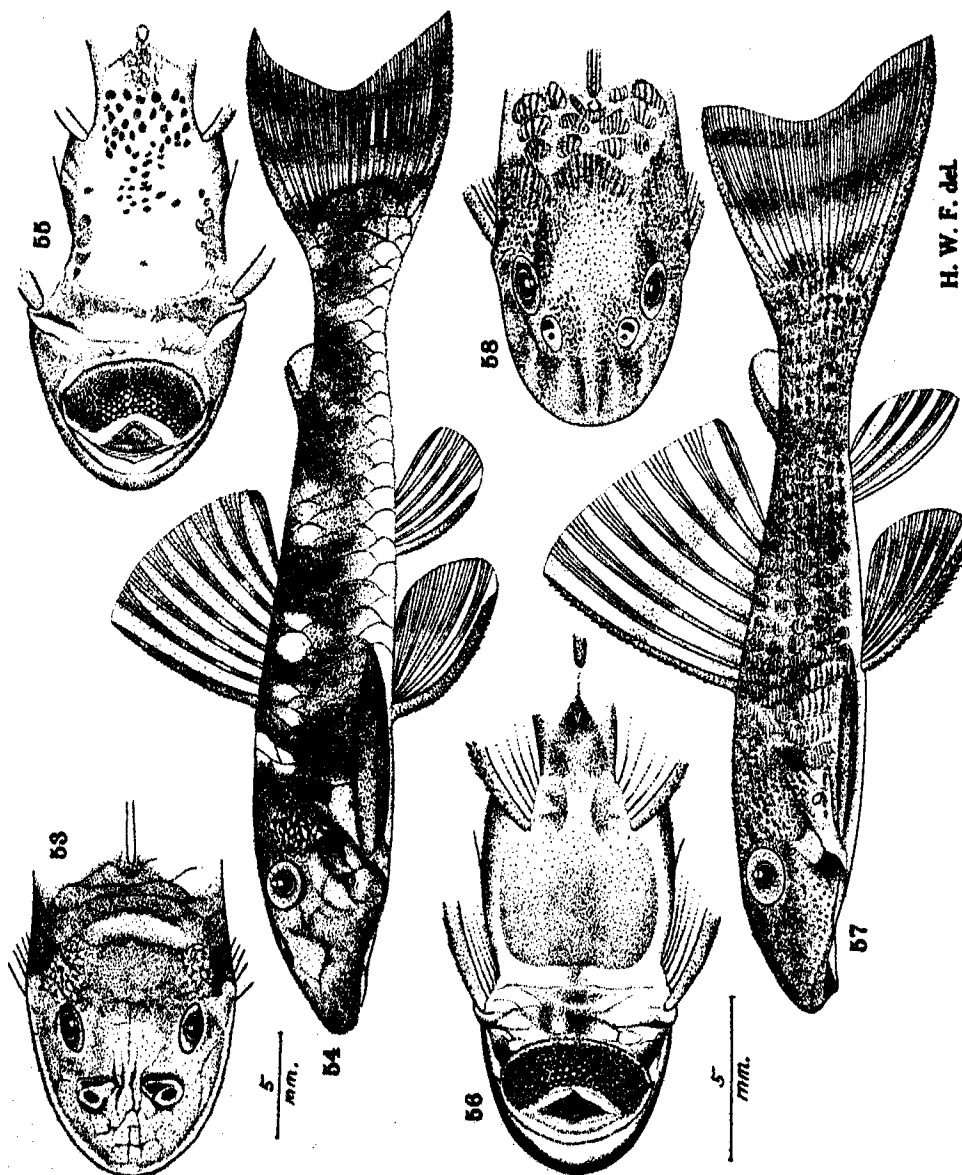
Color in alcohol brown, little paler below or on under surface of head, belly and tail. General appearance greatly subdued. Dark postocular diffuse area on top of head. On back 6 dark blotches, first close before dorsal, second at front dorsal base and third at last of dorsal base, fourth before and below front of adipose fin, fifth at hind part of adipose fin and sixth at upper part of caudal peduncle. Iris gray. Fins all largely pale brownish, only caudal with traces of 3 darker transverse bands and dark suffusion at middle of its base.

A. N. S. P. no. 69410. Campina Grande, Parahyba. 1936. Length 54 mm. Type.

A. N. S. P. nos. 69411 to 69413, same data, paratypes. Length 38 to 46 mm.

<sup>11</sup> Revista Mus. Paulista, São Paulo, vol. 8, 1911, p. 387 (type locality, "Rio Pardo, perto de Barretos, Est. S. Paulo, quasi na foz do rio, que e affluente do Rio Grande, por sua vez tributario do lado, esquerdo do Rio Parana").

<sup>12</sup> Op. cit., p. 390 (type locality, "Rio Pardo, egualmente do Rio Pardo perto de Barretos").



FIGS. 53 to 55.—*Plecostomus spilosoma* new species.  
 FIGS. 56 to 58.—*Ancistrus salgadæ* new species.

A. N. S. P. no. 69414. Rio Choró, Ceará, near Forteleza. 1936. Length 46 mm. Paratype.

A. N. S. P. nos. 69415 to 69416. Rio Choró, Ceará. 1936. Length 52 to 54 mm. Paratypes.

A. N. S. P. nos. 69417 to 69439. Rio Salgade, Icó, Ceará. 1937. Length 24 to 33 mm. Paratypes.

Characterized by its contrasted coloration, the presence of 4 transverse dark to blackish brown bands on the pale or light brown body, dorsal with 2 rows of dark brown spots and caudal with 3 dark transverse bands.

*Plecostomus scaphyiceps* Nichols<sup>13</sup> is based on specimens 35 to 50 mm. long without caudal. They differ at once in coloration, which is described with "A few spots on dorsal, ventral and caudal, tending to form broken oblique bands; otherwise immaculate." Its eye is given as 7 in head and adipose spine  $4\frac{1}{2}$ .

The type and paratypes from the Rio Choró all differ from the Rio Salgade material in their more definitely defined 4 or 5 lateral asperous plates along each side (near pectoral fins). Although much of the coloration is subdued, evidently from formalin preparation, it is similar in pattern. The predorsal scutellation is variable, though the scales all larger in the larger specimens.

(σπίλος blot + σῶμα body; with reference to the coloration.)

***Ancistrus salgadae* new species**

Figures 56 (head below), 57 (lateral view) and 58 (head above).

Depth  $5\frac{3}{4}$ ; head 4, length  $1\frac{1}{6}$  in its width. Snout (in profile)  $1\frac{1}{2}$  in head; eye 3, 2 in snout,  $1\frac{3}{4}$  in interorbital; mouth width  $1\frac{3}{4}$  in head; buccal disk width  $1\frac{1}{4}$ , with broad papillate lower lip, on each side very short cirrus; 10 to 12 very slender minute teeth each side of each jaw; interorbital  $1\frac{1}{4}$  in head, low, depressed, level. Gill opening subequal with eye, small, partly below hind eye edge.

Scutes imperfect, 21+2 in lateral series; 3 imperfect predorsals. Scutes all show longitudinal striae, each with a row of fine spinules. Entire under surface of head and belly naked.

D. I, 7, long slender spine spinescent on outer margin terminally, length 3 in fish without caudal; adipose fin  $1\frac{1}{4}$  in head, long spine with spinules along its upper edge; A. I, 4, spine  $1\frac{1}{4}$ ; least depth of caudal peduncle  $2\frac{1}{4}$ ; caudal  $2\frac{1}{2}$  in rest of fish, emarginate, with upper lobe much shorter and both uppermost and lowermost rays enlarged, with outer margin of each spinescent; pectoral  $3\frac{1}{2}$ , rays I, 4, depressed spine enlarged; ventral  $3\frac{1}{4}$ , rays I, 5, outer surface of enlarged spine spinescent.

Color in alcohol brown, under surface of head and belly, also of tail pale to whitish. Dark postocular bar inclined up to occiput and another parallel, lower and along suprascapular region. Four dark blotches on body, first below front of dorsal, second below hind part of dorsal, third from

<sup>13</sup> Revista Mus. Paulista, São Paulo, vol. 11, 1919, p. 7 (type locality, Cerqueira Cezar, State of São Paulo).

adipose fin and last at caudal base. Also scattered dark spots in dark blotches and along lower side of tail. Iris gray. Fins all pale generally. Dorsal with 3 longitudinal dark bands, one terminal, one medial and one basal. Dark blotch at front of adipose fin basally. Caudal with 3 dark parallel inclined bands. Pectoral with 3 dark obscure transverse bands, and ventral with 2, distinct. Anal uniformly pale.

A. N. S. P. no. 69440. Rio Salgade, Icó, Ceará. 1937. Length 29 mm. Type.

Though a young specimen it may be characterized by the broad soft skinny front marginal area of the head. The entire ventral surface of the head and trunk smooth, without asperities or scutes. The long caudal is greatly longer than the dorsal. *Ancistrus barra* Steindachner<sup>14</sup> is with "Die Unterseite des Kopfes und die Bauchgegend ist dicht mit sehr kleinen korntartigen, rauhen Plättchen bedeckt", and the fins with: D. I, 10; A. I, 5; scales 24(1).

(Named for the Rio Salgade.)

*Pseudancistrus genisetiger* new species

Figures 59 (head below), 60 (lateral view), 61 (head above) and 62 (interopercular bristles).

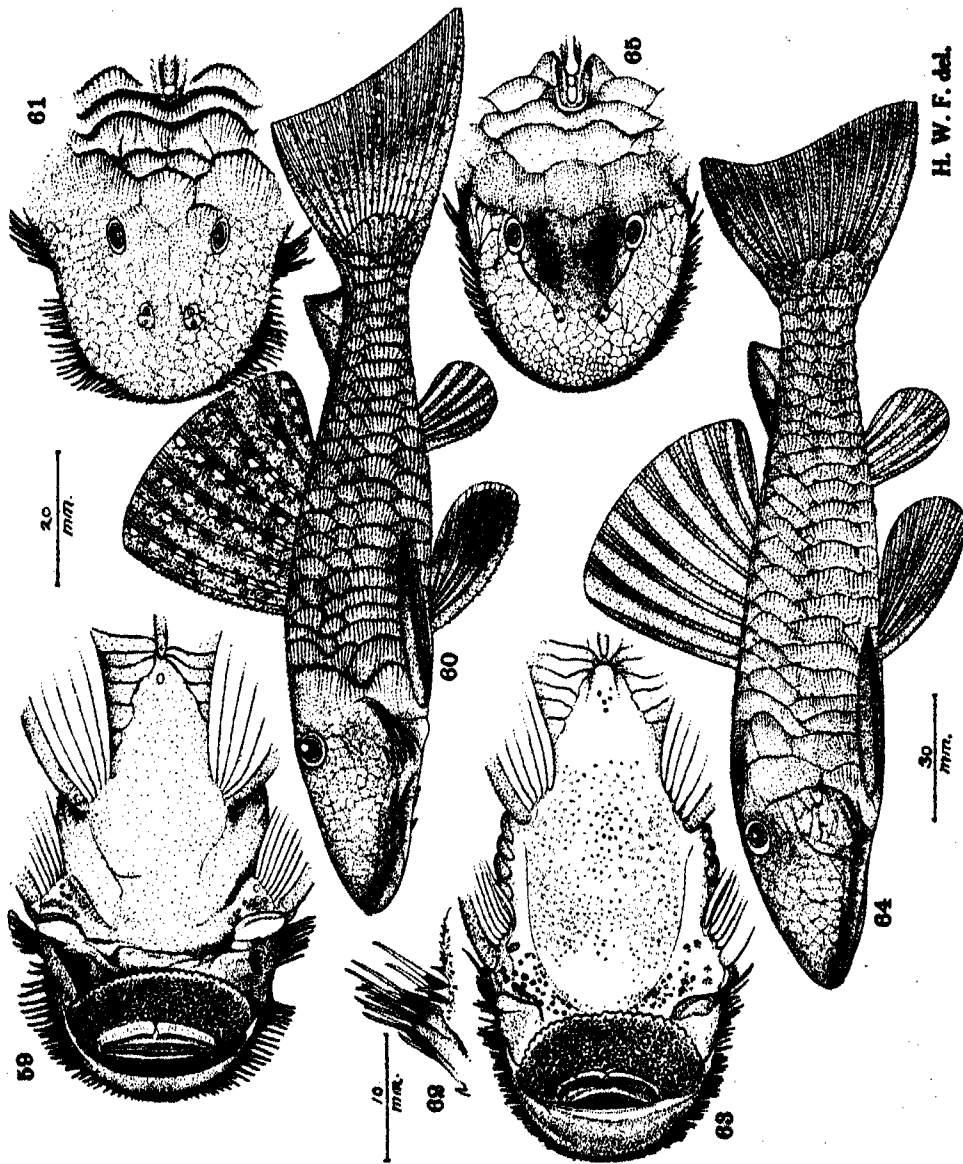
Depth  $4\frac{1}{2}$ ; head 3, length  $1\frac{1}{2}$  in its width. Snout (in profile)  $1\frac{1}{2}$  in head; eye  $5\frac{1}{2}$ ,  $4\frac{1}{2}$  in snout,  $2\frac{1}{2}$  in interorbital; mouth width  $1\frac{1}{2}$  in head; buccal disk width  $1\frac{1}{2}$ , with broad papillate lower lip, on each side slender cirrus  $\frac{1}{2}$  of eye; 50 to 60 fine slender short teeth in each side of each jaw; interorbital  $2\frac{1}{2}$  in head, low, depressed, little elevated convexity above each eye. Gill opening length twice eye, low and largely below eye.

Scutes 20+1 in lateral series; 5 transversely between dorsal and ventral origins; 3 predorsal. All scutes on body and head minutely asperous, rough to touch, each with longitudinal keel, these made up of a series of small or minute denticles with last one usually little larger than others and all directed back. Lower margin of head with row of prominent bristles, of which posterior largest. Still longer bristles terminally hooked, clustered on interopercle, longest equal  $1\frac{1}{2}$  eye diameters. Entire under surface of head and belly covered with smooth skin.

D. I, 7, slender spinescent and terminally flexible spine  $1\frac{1}{2}$  in head; adipose fin  $2\frac{1}{2}$ , with strong deep spine; A. I, 5, first ray  $2\frac{1}{2}$ ; least depth of caudal peduncle  $3\frac{1}{2}$ ; caudal  $2\frac{1}{2}$  in rest of fish, lower lobe greatly longer and hind edge very slightly emarginate; pectoral  $1\frac{1}{2}$ , with broadly compressed spinescent spine, rays I, 6; ventral rays I, 5, fin  $1\frac{1}{2}$  in head.

Color in alcohol dark umber or blackish brown generally. Under surface of head and belly but little paler or dark drab brown. Iris dark gray. Bristles marginally on front and sides of head whitish, basal investing tissues blackish. Fins all dull umber like body and upper surfaces. Each dorsal ray with 4 to 6 whitish spots or blotches, also smaller more numerous and obscured ones along each caudal ray. Other fins all more or less dark gray terminally.

<sup>14</sup> Anzeiger Akad. Wiss. Wien, vol. 47, nr. 27, 1910, p. 58 (type locality, "Rio San Francisco bei Barra").



FIGS. 59 to 62.—*Pseudancistrus genisetiger* new species.  
 FIGS. 63 to 65.—*Pseudancistrus papariae* new species.

A. N. S. P. no. 69441. Rio Jaguaribe, Orós, Ceará. 1936. Length 145 mm. Type.

Closely related to *Pseudancistrus nigrescens* Eigenmann<sup>15</sup> but differing chiefly in proportions. The scutellation of the predorsal is quite different from Eigenmann's drawing of the predorsal as the broadly angular supra-occipital of my specimen articulates behind with 2 nearly as large plates, then is followed by 3 plates the last 2 of which are greatly narrowed. Eigenmann does not figure or describe the buccal disk, which is very large and broad in my specimen. Compared with Kner's figures of *Hypostomus barbatus*<sup>16</sup> where its width is shown as equal to the length of the snout, in my specimen it is equal to the combined length of the snout and eye. The white spots on the dorsal are fairly distinct if not pronounced, and the other fins all uniform dark brown, without a pale hind border to the caudal.

(Gena cheek + setiger bristles + fero to bear.)

*Pseudancistrus papariae* new species

Figures 63 (head below).  
64 (lateral view) and 65  
(head above).

Depth  $4\frac{1}{2}$  to  $4\frac{3}{4}$ ; head  $3\frac{1}{2}$  to  $3\frac{3}{4}$ , length  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in width. Snout (in profile)  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in head; eye 5 to  $5\frac{1}{2}$ ,  $3\frac{3}{4}$  to 4 in snout, 2 to  $2\frac{3}{4}$  in interorbital; mouth width  $1\frac{1}{2}$  to  $2\frac{1}{2}$  in head; buccal disk width 1 to  $1\frac{1}{4}$ , with broad papillate lower lip, on each side slender cirrus nearly or quite as long as eye; each side above 40 slender, short, hooked, bifid teeth and 50 each side below; interorbital 2 to  $3\frac{1}{2}$  in head, low, depressed or flattened, each superciliary region of eye little elevated. Gill opening 2 to  $2\frac{1}{2}$  times eye, front portion entirely below eye.

Scutes 21+2 in lateral series; 4 transversely between dorsal and ventral origins; 3 predorsal. All scutes on body and head minutely asperous, rough to touch, and each with longitudinal striae bearing row of small sharp spines directed back, last spinule little enlarged. Front and lateral margin of head with a row or band of short bristles, posterior longest. Interopercle with cluster of 6 long bristles, longest  $1\frac{1}{2}$  times eye. Entire under surface of head and belly naked, covered with smooth skin. Along scutes bordering dorsal fin base each side with a keel extending back to adipose fin.

D. I, 7, slender spine little spinescent, terminally flexible, first ray  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in head; adipose fin  $2\frac{1}{2}$  to  $2\frac{3}{4}$ ; A. I, 5, second ray  $1\frac{1}{2}$  to 3, slender spine terminally flexible; least depth of caudal peduncle  $2\frac{1}{2}$  to  $3\frac{1}{4}$ ; caudal  $2\frac{1}{2}$  to 3 in rest of fish, lower lobe much longer and hind edge slightly emarginate; pectoral  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in head, rays I, 6, large spinescent spine terminally flexible; ventral  $1\frac{1}{2}$  to  $1\frac{3}{4}$ , rays I, 5, large spine terminally flexible.

Color in alcohol uniform dark umber. Under surface of head and belly scarcely paler, more livid or dark drab. Iris dark gray. Fins all uniformly brown.

<sup>15</sup> Mem. Carnegie Mus., vol. 5, June 1912, p. 234, text fig. 35 (head above), pl. 25, fig. 2 (type locality, Amatuk, British Guiana).

<sup>16</sup> Denks. Akad. Wiss. Wien, vol. 7, 1854, p. 268, pl. 2, figs. 2-2a (no locality).

A. N. S. P. no. 69442. Lago Papary, Rio Grande do Norte. 1936. Length 192 mm. Type.

A. N. S. P. nos. 69443 to 69444, same data, paratypes. Length 67 to 144 mm.

A. N. S. P. nos. 69445 to 69446. Rio Jaguaribe, Orós, Ceará. 1936. Length 108 to 123 mm.

Closely related to the preceding *Pseudancistrus genisetiger*, but differs in the lesser development of the bristles along the sides of the head and on the interopercle. Also the first plate behind the supraoccipital greatly larger than all the others of the predorsal series. In this respect it approaches *Pseudancistrus depressus* (Günther),<sup>17</sup> but it differs in the absence of white dots on comparison with Steindachner's figure, his specimen 115 mm. long. Günther's type is 152 mm. long and is described with the eye "two-thirds of the width of the interorbital space" while Steindachner shows it but  $1\frac{1}{4}$ , therefore the latter may represent still another species.

(Named for Lago Papary.)

***Pterygoplichthys lituratus* (Kner)**

*Ancistrus lituratus* Kner, Denks. Akad. Wiss. Wien, vol. 7, 1854, p. 285, pl. 5, fig. 3 (type locality, "aus dem Rio Guaporé bei Cidade do Matogrosso").—Regan, Trans. Zool. Soc. London, vol. 17, pt. 3, Oct. 1904, p. 227 (R. Amazon; Eastern Brazil).

*Loricaria liturata* (Natterer) Kner, op. cit. (name in synonymy).

Two, 244 to 258 mm., Forteleza, Ceará.

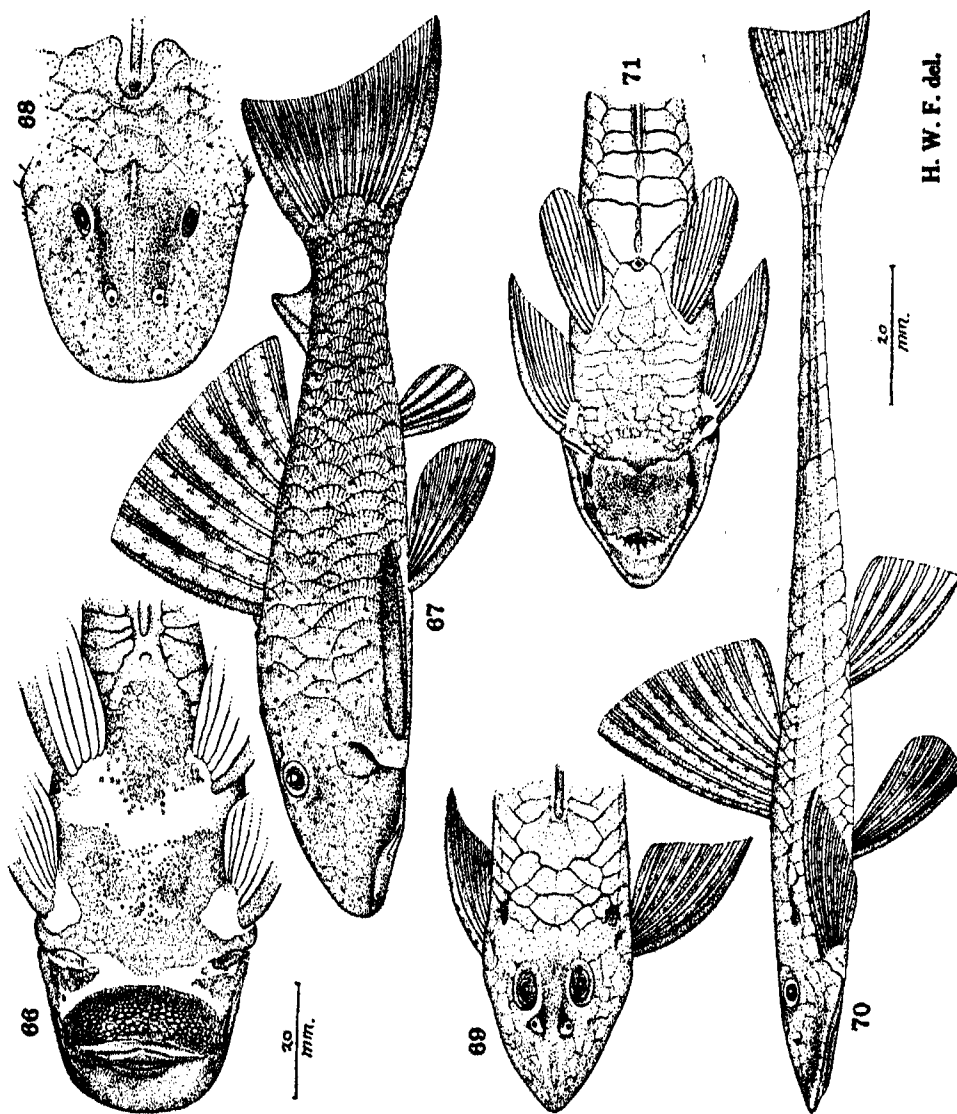
***Chaetostomus eptingi* new species**

Figures 66 (head below),  
67 (lateral view) and 68  
(head above).

Depth  $4\frac{1}{2}$  to  $4\frac{3}{4}$ ; head  $3\frac{1}{4}$  to  $3\frac{3}{4}$ , length  $1\frac{1}{2}$  to  $1\frac{1}{4}$  in its width. Snout (in profile)  $1\frac{1}{4}$  in head; eye 4 to  $4\frac{1}{2}$ ,  $3\frac{1}{2}$  to  $3\frac{3}{4}$  in snout,  $2\frac{1}{4}$  to  $2\frac{3}{4}$  in bony interorbital; mouth width  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in head; width of buccal disk  $1\frac{1}{10}$  to  $1\frac{1}{8}$ , both lips papillate, with marginal cirrus each side  $1\frac{1}{2}$  to 2 in eye; mandibular ramus  $1\frac{1}{4}$  to  $1\frac{3}{4}$  in interorbital; teeth 35 each side above, slender, fine, curved and bifid terminally, and 35 on each mandibular ramus; interorbital  $1\frac{1}{4}$  to 2 in head, nearly level with slight median ridge and convex supraorbital little elevated each side; supraoccipital very short obtuse point, with slight median ridge, also slightly protruding in upper profile; interopercle with a few very short sharply conic spines. Gill opening largely below eye.

Scutes 23 to 25 + 2 in lateral series; 4 transversely between dorsal and ventral origins; 3 predorsal. On under surfaces very variable and irregular, obsolete or ill-defined spinescent scutes, chiefly in interpectoral region, each side of belly anteriorly and in interventral region. Each side of head below a triangular spinescent area, otherwise largely smooth and entire. Each row of scutes on back and above with median obsolete longitudinal ridge. Each specimen with small round foramen-like smooth median area, size of pupil, on front edge of snout.

<sup>17</sup> *Chaetostomus depressus* Günther, Proc. Zool. Soc. London, 1868, p. 232 (type locality, "probably from Surinam").—Steindachner, Denks. Akad. Wiss. Wien, vol. 43, 1882, p. 123, pl. 5, figs. 1-1a (head) (Surinam).

FIGS. 66 to 68.—*Chaetostomus eptingi* new species.FIGS. 69 to 71.—*Loricariichthys parnahybae* new species.



D. I, 7, slender spine finely asperous, terminally flexible and subequal with head; adipose fin 2 to  $2\frac{1}{4}$ , large spine compressed; A. I, 4, first ray  $2\frac{1}{4}$  to  $2\frac{1}{2}$ , slender spine terminally flexible; least depth of caudal peduncle  $2\frac{1}{4}$  to  $2\frac{3}{4}$ ; caudal  $2\frac{1}{4}$  to  $2\frac{1}{2}$  in rest of fish, lower lobe greatly longer and hind edge slightly emarginate; pectoral  $2\frac{3}{8}$  to  $2\frac{1}{2}$ , enlarged robust spine but slightly compressed, firm and with rather large spinules terminally above, rays I, 6; ventral rays I, 5, fin 1 to  $1\frac{1}{2}$  in head.

Color in alcohol dark amber, largely uniform, under surface of head and belly scarcely paler or rather of sienna tint. Both head and body with obscure small darker or blackish spots, rather numerous on head, and fewer and with more scattered appearance on body. Iris dark gray. Fins all umbrous, or rather dark brown. Dorsal with 2 rows of ill-defined blackish spots on each membrane, with each row close to fin ray and 5 to 7 spots in a row. Adipose and anal fins immaculate. Caudal with dark spots along uppermost and lowermost rays, and traces of 5 very faint transverse streaks. Paired fins with rather obsolete dark spots.

A. N. S. P. no. 69447. Forteleza, Ceará. Length 165 mm. Type.

A. N. S. P. nos. 69448 to 69450, same data, paratypes. Length 148 to 155 mm.

Characterized by the broad interorbital, which is 2 in the head. It thus approaches the Peruvian *Chaetostomus maculatus* Regan and *Chaetostomus marcapatae* Regan. It differs markedly from both in the very small or little developed interopercular spines. Other characters are the long pectoral spines, well spinescent above terminally and overlapping ventral bases, dorsal I, 7, supraorbital region little elevated convexly each side of slightly lowered interorbital, rather large eye, predorsal length long as dorsal fin and width of buccal disk little greater than snout.

(For Mr. William J. Epting of Philadelphia, who secured many American fishes for the Academy.)

***Parahemiodon spixii* (Steindachner)**

*Loricaria spixii* Steindachner, Denks. Akad. Wiss. Wien, vol. 44, 1882, p. 4, pl. 2 (type locality, "Rio Parahyba; Santa Cruz am Rio Quenda; Rio Muriahe; São Matheos; Sambaia; Rio grande do Sul").—Regan, Trans. Zool. Soc. London, vol. 17, pt. 3, Oct. 1904, p. 289 (Southeast Brazil).

Two, 158 to 173, Forteleza, Ceará. These agree with Steindachner's figures, especially in the male with the very large lower lip. They have 18 or 19 scutes in the lateral keels before their convergence, which falls slightly before the tip of the depressed anal.

***Parahemiodon derbyi* (Fowler) "Casculo."**

*Loricariichthys derbyi* Fowler, Proc. Acad. Nat. Sci. Phila., April 1915, p. 267, fig. 4 (type locality, Rio Jaguaribe at Barro Alto, Brazil).

Sixteen, 50 to 125 mm., Rio Jaguaribe, Russas, Ceará. 1936. Smaller ones with 6 blackish transverse bands across the back; in smallest first, second, fourth and sixth bands broader than the others.

Five, 137 to 179 mm., Forteleza, Ceará.

One, 150 mm., Rio Parnahyba, Piahy. 1936.

One, 180 mm., Rio Jaguaribe, Ceará. 1936.

One, 183 mm., Rio Jaguaribe, Orós, Ceará. 1936.

Four, 145 to 180 mm., Rio Salgade, Icó, Ceará. Largest evidently a male with greatly developed and fringed lower lip. A careful comparison reveals no structural differences from the other materials.

*Loricaria jaraguensis* Steindachner<sup>18</sup> is said to have the belly with 5 longitudinal rows of plates between the hind lateral rows and anteriorly 10 to 15 rows, narrower interorbital, papillate lips with short lateral tentacles and upper rounded, and 4 dark cross bands on the back.

*Loricariichthys parnahybae* new species "Cascudo." Figures 69 (head above), 70 (lateral view) and 71 (head below).

Depth  $11\frac{1}{2}$ ; head  $6\frac{1}{2}$ , width 1. Snout (in profile)  $1\frac{1}{2}$  in head; eye 4,  $2\frac{1}{2}$  in snout, greater than interorbital; posterior orbital notch 3 in eye; buccal disk width  $1\frac{1}{2}$  in head; lower lip broad, covered with very minute and numerous papillae, with very short cirrus on each side, and 6 short fleshy tentacles on edge of upper lip each side; 8 small slender teeth, ends curved and bifid, each side above and 8? each side below; mandibular ramus  $1\frac{1}{2}$  in interorbital; interorbital 5, slightly concave, with orbital ridge each side only slightly elevated. Gill opening extends forward opposite middle of eye, length equals entire orbital socket inclusive of posterior orbital notch.

Scutes 30+1 in lateral axial series; 3 well defined predorsal. Two lateral keels approximate closely behind anal fin, ending in spine behind on each scute. Lower surface of head smooth, naked. Scutes 11 transversely across breast between front parts of each pectoral. At middle of belly only 2 or 3 scutes in transverse series, and in interventral region 4.

D. I, 7, very slender and finely asperous spine terminally flexible, 5 in fish without caudal; A. I, 5, slender spine like dorsal spine and equals head; caudal (broken) 1?; least depth of caudal peduncle 2 in eye; pectoral  $5\frac{1}{2}$  in fish without caudal, rays I, 6, compressed spine terminally flexible and asperous; ventral equals head, rays I, 5.

Color in alcohol brown, nearly burnt umber, slightly lighter on under surfaces. Iris dark gray. Buccal disk pale brown. Fins all pale to very light brownish. Dorsal with row of rather dark gray spots, with 9 along spine and each ray with row along front edge or portion down to 4 in number on last ray. All other fins with variable indistinct gray spots, most evident on caudal.

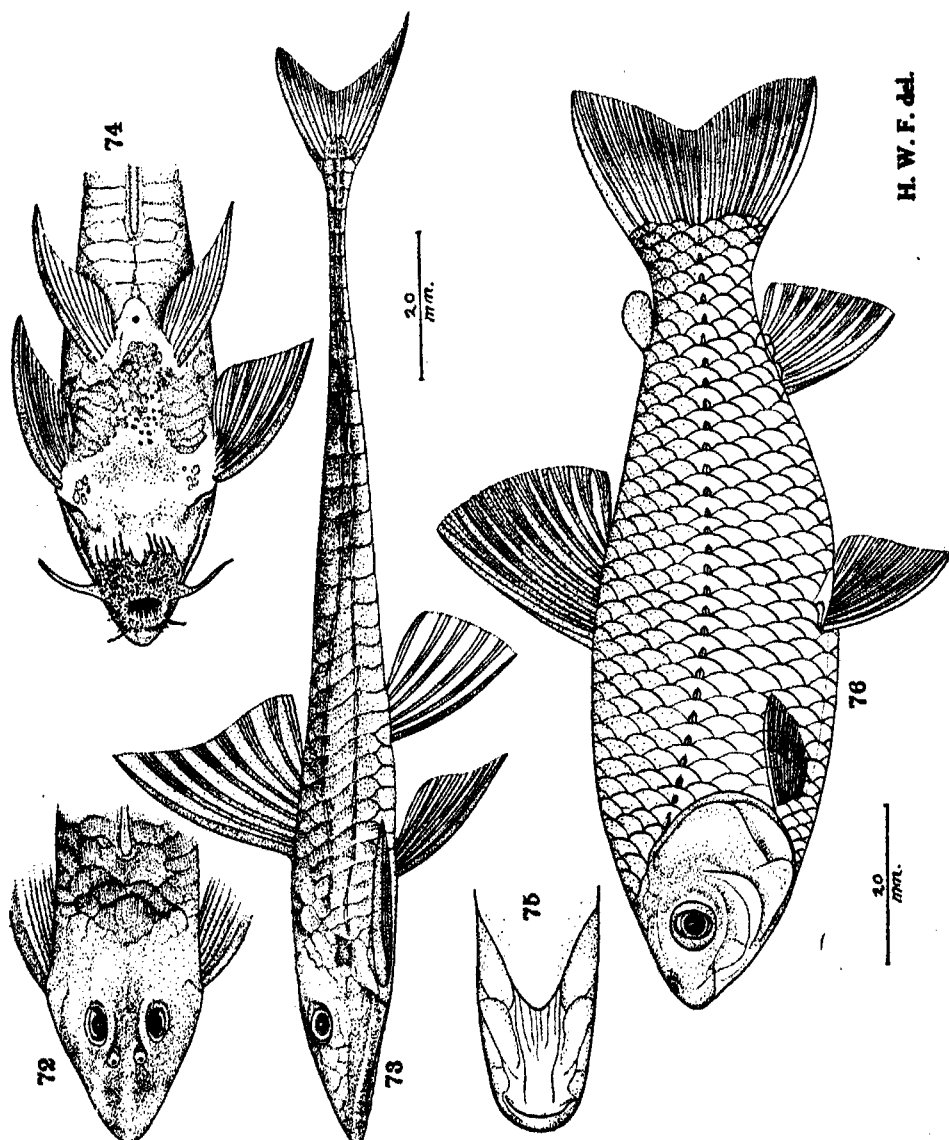
A. N. S. P. no. 69451. Rio Parnahyba, Therizina, Piahy. 1936. Length 155 mm. Type.

Very similar to *Loricaria grisea* Eigenmann<sup>19</sup> especially in the structure

<sup>18</sup> Anzeiger Akad. Wiss. Wien, vol. 47, nr. 8, 1910, p. 57 (type locality, "Flussgebiete des Jaragua und der Ribeira im Staate S. Paulo und Sa. Catharina").

<sup>19</sup> Ann. Carnegie Mus., vol. 9, no. 1, Aug. 17, 1909, p. 8 (type locality, Conavaruk, British Guiana; Bartica).

*Loricariichthys griseus* Eigenmann, Mem. Carnegie Mus., vol. 15, June 1912, p. 246, pl. 30, fig. 2 (dorsal view, photograph) (types).



FIGS. 72 to 74.—*Loricaria piauhiae* new species.  
 FIGS. 75 and 76.—*Curimata elegans* Steindachner.

of the upper lip, narrow interorbital and general appearance. Eigenmann does not indicate the point of convergence of the lateral keels, simply stating "scutes 18 or 19+11, the lateral keels remaining separate throughout." In my specimen they are 19+11+1, the convergence falling 2 scutes behind the end of the depressed anal. His dorsal view shows a larger, broader and blunt supraoccipital, pointed in my specimen. The last further differs in the interorbital space less than the eye diameter, exclusive of the orbital notch.

(Named for the Rio Parnahyba.)

*Loricaria piauhiae* new species "Cascudo."

Figures 72 (head above),  
73 (lateral view) and  
74 (head below).

Depth  $9\frac{1}{2}$ ; head  $6\frac{1}{2}$ , width 1. Snout (in profile)  $1\frac{1}{2}$  in head; eye  $4\frac{1}{2}$ ,  $3\frac{1}{2}$  in snout,  $1\frac{1}{2}$  in interorbital; posterior orbital notch shallow,  $\frac{1}{4}$  of eye; buccal disk width 2 in head; lips moderate, lower wider, and both furnished with very small pointed fleshy papillae or tentacles, those posteriorly marginal on lower lip longer and forming sort of fringe, and lateral long filament each side reaching into gill opening or length 2 in snout; 6 long slender compressed teeth above, outer shorter, all curved and each with short lateral prong; 6 small bifid slender teeth on each mandibular ramus, ends curved; mandibular ramus  $1\frac{1}{4}$  in interorbital; interorbital  $4\frac{1}{2}$  in head, depressed, with orbital ridge each side slightly elevated. Gill opening extends forward opposite first fourth in eye, length equals  $1\frac{1}{2}$  in snout.

Scutes 32+1 in lateral axial series; 3 well developed predorsals. Two lateral keels approximate little before end of depressed anal fin, ending in spine behind on each scute. Lower surfaces of head, chest and breast smooth, naked, only a few obsolete scutes laterally behind gill openings and near pectoral bases. Seven plates along each side of belly between pectorals and ventrals, and between them and also in interventral region, area comprising 3 or 4 scutes transversely.

D. I, 7, very long slender spine finely asperous anteriorly and terminally flexible, length  $4\frac{1}{2}$  in fish without caudal; A. I, 5, slender spine like that of dorsal and length  $6\frac{1}{2}$  or subequal with head; caudal (broken) emarginate, lower lobe longer; least depth of caudal peduncle 2 in eye; pectoral  $5\frac{1}{2}$  in fish without caudal, rays I, 6, slender compressed spine spinescent and terminally flexible; ventral subequal with pectoral, spine similar and rays I, 5.

Color in alcohol rather dark sienna, under surface of head and belly slightly paler. Iris grayish. Fins all uniform or brownish.

A. N. S. P. no. 69452. Rio Parnahyba, Therezina, Piauh. 1936. Length 148 mm. Type.

Only the type obtained. Closely related to *Loricaria evansi* Boulenger,<sup>20</sup> but that species has the supraoccipital with a single serrated keel, scutes 31 (19+12) [31 (16+15) in *Loricaria piauhiae*] abdomen with a series of 8 plates on each side, width of body at level of first anal ray  $3\frac{1}{2}$  times in dis-

<sup>20</sup> Ann. Mag. Nat. Hist., ser. 6, vol. 10, 1892, p. 10, pl. 1 (type locality, Rio Jungada, Matto Grosso).—Regan, Trans. Zool. Soc. London, vol. 17, pt. 3, Oct. 1904, p. 290 (type).

tance from that point to caudal ( $5\frac{1}{4}$  in *Loricaria piauhyae*). *Loricaria nudiventris* Valenciennes 1840 is said by Regan to have the abdomen with a series of 4 lateral plates on each side.

(Named for Piauhy.)

## CHARACIDAE

### CURIMATINAE

**Curimata elegans** Steindachner "Piabussú" "Curimatã", "Saguirú."  
 Figures 75 (head below) and 76  
 (lateral view, Lago Papary).

*Curimatus elegans* Steindachner, Sitzsb. Akad. Wiss. Wien, vol. 70, pt. 1, 1874, p. 529 (type locality, "Rio Arassuahy, ein Nebenfluss des Jequitinhonha in der Provinz Minas Geraes").—Eigenmann and Eigenmann, Ann. N. Y. Acad. Sci., vol. 4, 1889, p. 421 (R. Arassuahy; R. Ipajica at Pernambuco; Bahia).—Starks, Fish. Stanford Exped. Brazil, 1913, p. 14 (L. Extremos; L. Papary; Ceara Mirim).

One, 88 mm., Rio Jaguaribe, Orós, Ceará. 1937.

Three, 70 to 75 mm., Rio Jaguaribe, Russas, Ceará. 1937. In poor preservation. One of the smallest with lower caudal lobe largely blackish. Dark basal dorsal blotch large as pupil and caudal spot rather diffuse, large as eye.

Four, 103 to 118 mm., Lago Papary, Rio Grande do Norte. 1936.

*Prochilodus pterostigma* Fowler<sup>21</sup> is wrongly included in *Prochilodus* and should correctly be known as *Curimata pterostigma* (Fowler). It is evidently related to *Curimata elegans* but has much smaller scales, or 44+2 in the lateral line.

**Curimata saguiru** new species "Saguirú." Figure 77.

Depth  $2\frac{1}{2}$  to  $2\frac{3}{4}$ ; head  $2\frac{3}{4}$  to  $3\frac{1}{2}$ , width 2 to  $2\frac{1}{2}$ . Snout (in profile) 4 to  $4\frac{1}{2}$ ; eye  $4\frac{1}{2}$  to  $4\frac{3}{4}$ , equal to or greater than snout,  $1\frac{1}{2}$  to 2 in interorbital, with broad adipose lids; maxillary largely sheathed, reaches  $\frac{2}{3}$  to  $\frac{3}{4}$  to eye, length 5 to  $6\frac{1}{2}$  in head; interorbital  $2\frac{1}{2}$  to  $2\frac{3}{4}$ , well elevated convexly, with broad fontanel extending back to occiput. No distinct gill rakers; gill filaments  $1\frac{1}{2}$  in eye.

Scales 40 to 45+3 or 4 in lateral line; 11 above, 8 below to ventral origin, 8 below to anal origin, 35 or 36 predorsal. Ventral axillary scale  $2\frac{3}{4}$  to  $3\frac{1}{2}$  in fin. Scales largest on costal region below lateral line with rows converging narrower on caudal peduncle, very small and crowded on predorsal. Caudal base scaly and anal with basal scaly sheath. Scales with 7 obtuse points on apical edge, and basal edge with 3 lobes.

D. III, 9, first branched ray  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in head; adipose fin  $3\frac{1}{2}$  to  $3\frac{3}{4}$ ; A. III, 7, first branched ray 2 to  $2\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{3}{4}$  to  $2\frac{1}{2}$ ; caudal 3 to  $3\frac{1}{2}$  in rest of fish, well emarginate behind; pectoral rays I, 12, fin  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in head; ventral  $1\frac{1}{2}$  to  $1\frac{3}{4}$ , rays I, 7.

Color in alcohol olivaceous on back, sides and below brownish. Fins all brown, without markings.

<sup>21</sup> Proc. Acad. Nat. Sci. Phila., Dec. 18, 1913, p. 520, fig. 3 (type locality, Madeira River about 20 miles north of Porto Velho, Brasil).

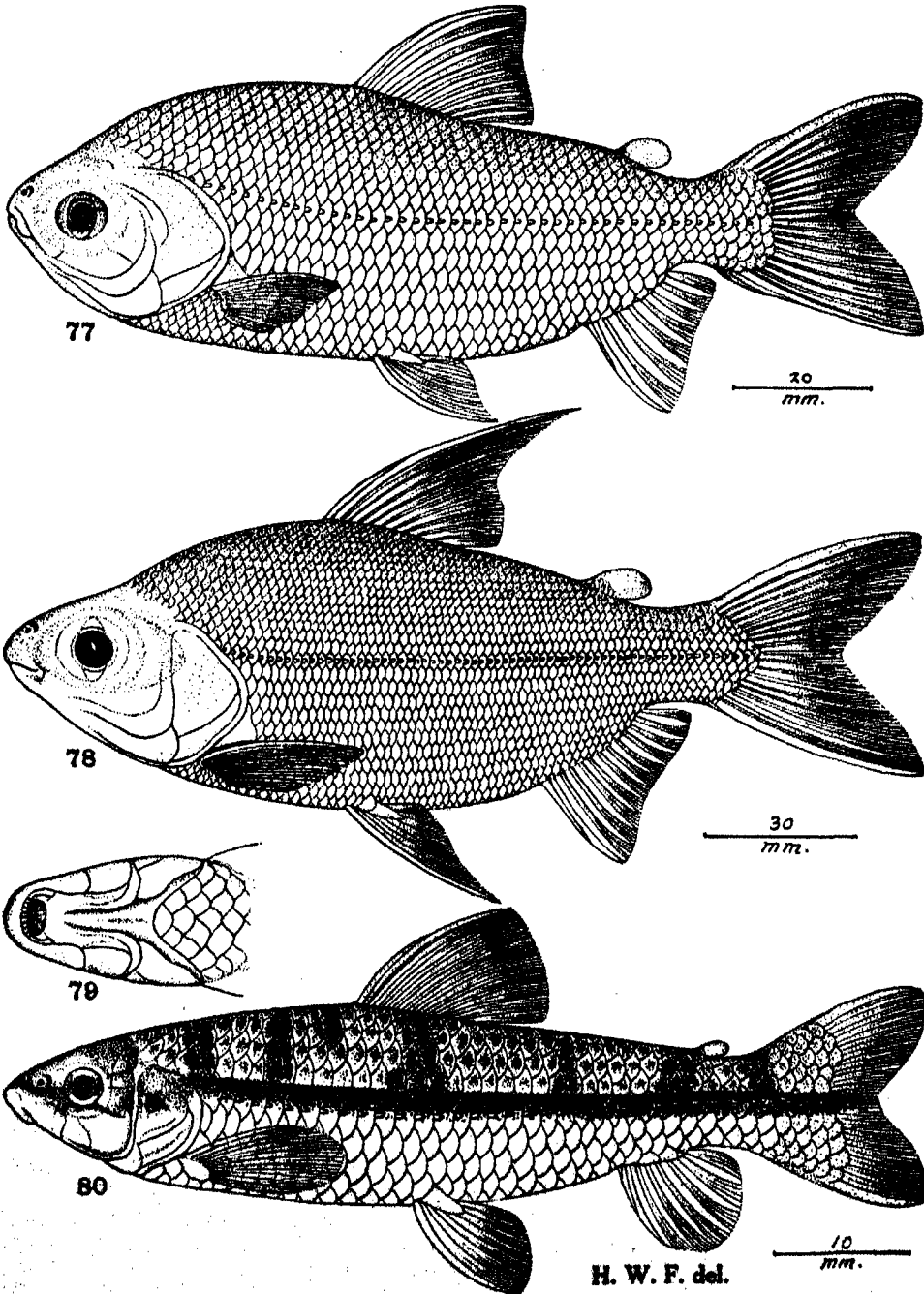


FIG. 77.—*Curimata saguira* new species.

FIG. 78.—*Acuticurimata macrops* (Eigenmann and Eigenmann).

FIGS. 79 and 80.—*Apareiodon davisii* new species.

A. N. S. P. no. 69461. Lago Papary, Rio Grande do Norte. 1937. Length 132 mm. Type.

A. N. S. P. nos. 69462 and 69482, same data, paratypes. 1936. Length 114 to 116 mm.

A species apparently related to *Curimatus isognathus* Eigenmann and Eigenmann<sup>22</sup> in its equal jaws, fin rays and proportions. It differs in larger scales, 35 to 40+4 in the lateral line (51 to 53 in *Curimatus isognathus*). Eigenmann and Eigenmann note the scales as all ciliate, though in my specimens only very slightly and sparsely furnished with minute points.

(*Saguiru* the Brazilian name.)

**Curimata cyprinoides** (Linnaeus) "Piabas", "Branquinha."

*Salmo cyprinoides* Linnaeus, Syst. Nat., ed. 12, pt. 1, 1766, p. 514 (type locality, Surinam).  
*Curimatus cyprinoides* Eigenmann and Eigenmann, Ann. N. Y. Acad. Sci., vol. 4, 1889, p. 429 (Para).

*Curimata cyprinoides* Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 253 (Contamana, Peru).

Fifty-five, small specimens, Rio Jaguaribe, Russas, Ceará. 1936.

Three, 38 to 130 mm., Rio Jaguaribe, Russas, Ceará. 1937.

Two, 53 to 55 mm., Rio Jaguaribe, Ceará, 1936.

Four, 83 to 125 mm., Forteleza, Ceará. 1937.

Two, 135 to 160 mm., Therezina, Piahy. 1936.

One, 147 mm., Rio Parnahyba, Therezina, Piahy. 1936.

#### **ACUTICURIMATA** new genus

TYPE.—*Curimata macrops* Eigenmann.

Body moderately deep, well compressed. Head large, compressed, sides approximated below. Snout obtuse, well overhanging mandible. Eye very large, advanced in head, with broad adipose lids. Mouth broad, with very short gape, jaw edges firmly trenchant. Maxillary short, not reaching eye, concealed. No teeth. Tongue small. Broad suborbitals cover cheek. Opercle large. Gill opening wide. Gill rakers numerous, fine, slender, flexible points. Scales all small, largest on belly or preventral region. Ventral axil with alar scale. Lateral line axial along side of body, complete, tubes simple and small. Dorsal elevated, first rays form long point reaching adipose fin. Adipose fin rather long. Anal base long, rays 13. Pectoral short, reaches ventral. Ventral inserted below front of dorsal, longer than ventral.

Distinguished by its pointed dorsal, enlarged eyes and unusual physiognomy.

(*Acutus* pointed, with reference to the fins + *Curimata*.)

**Acuticurimata macrops** (Eigenmann and Eigenmann) "Branquinha."

Figure 78 (Therezina).

*Curimatus macrops* Eigenmann and Eigenmann, Ann. New York Acad. Sci., vol. 4, 1889, p. 429 (type locality, Rio Puty, San Gonçallo).

<sup>22</sup> Ann. New York Acad. Sci., vol. 4, 1889, p. 428 (type locality, "Lago Alexo; Ica; Manacapuru; San Paulo").

Depth  $2\frac{3}{8}$  to  $2\frac{3}{4}$ ; head  $2\frac{3}{4}$  to 3, width 2 to  $2\frac{1}{4}$ . Snout (in profile)  $3\frac{1}{4}$  to  $4\frac{1}{4}$  in head; eye 3 to  $3\frac{3}{8}$ , greater than snout,  $1\frac{1}{4}$  to  $1\frac{1}{2}$  in interorbital, broad adipose lids largely covering eye; maxillary reaches  $\frac{3}{4}$  to eye, length  $3\frac{3}{8}$  to  $4\frac{1}{8}$  in head; mouth width  $3\frac{3}{8}$  to  $4\frac{1}{4}$ ; interorbital  $2\frac{1}{4}$  to  $2\frac{3}{8}$ , broadly convex, moderately high; broad frontal fontanel reaching into occipital extension. Gill rakers  $22+36$ , short flexible points,  $\frac{1}{3}$  of gill filaments which are 2 in eye.

Scales 55 to  $57+4$  or 5 in lateral line; 19 above, 11 below to ventral origin, 12 below to anal origin; 30 predorsal, 12 preventral forward to pectoral base. Ventral axillary scale  $2\frac{3}{8}$  to  $3\frac{1}{2}$  in fin. Scales largest on pre-ventral and belly. Caudal base scaly and anal base with low scaly sheath. Scales with 6 or 7 very short small apical marginal denticles, and 3 shallow basal marginal lobes.

D. II, 9, first branched ray  $2\frac{1}{4}$  to 3 in fish without caudal; adipose fin 3 to  $3\frac{3}{8}$  in head; A. II, 11, first branched ray 2 to  $2\frac{1}{4}$ ; caudal  $2\frac{3}{8}$  to 3 in rest of fish, rather deeply forked; least depth of caudal peduncle  $2\frac{3}{8}$  to  $2\frac{7}{8}$  in head; pectoral  $1\frac{1}{2}$  to  $1\frac{3}{4}$ , rays I, 15; ventral rays I, 5, fin  $1\frac{1}{2}$  in head.

Color in alcohol uniform dull brown on back, sides and lower surfaces paler to whitish. Iris pale or whitish. Fins all dull brownish.

Two, 110 to 135 mm., Forteleza, Ceará.

Two, 167 to 170 mm., Therezina, Piahy. 1936.

#### PARODONTINAE

*Apareiodon davisi* new species "Peixe rei", "Piabas."

Figures 79

(head below) and 80.

Depth  $3\frac{1}{2}$  to 4; head  $3\frac{3}{4}$  to 4, width  $1\frac{1}{2}$  to  $1\frac{3}{4}$ . Snout (in profile)  $3\frac{1}{2}$  to  $3\frac{3}{4}$  in head; eye  $3\frac{3}{4}$  to 5, 1 to  $1\frac{3}{8}$  in snout,  $1\frac{1}{4}$  to  $1\frac{3}{8}$  in interorbital, lids free all around; mouth width 5 to 6; 8 broad, compressed teeth with edges minutely denticulate above; inner edge of each maxillary with very minute short and subbasal tooth; no lower teeth, firmly trenchant and truncate edge of mandible entire; interorbital  $2\frac{1}{2}$  to 3 in head, low, broadly convex; large suborbitals entirely cover cheek. Gill opening extends forward opposite hind vertical edge of preopercle. Gill rakers  $3+13$ , short lanceolate points,  $\frac{1}{2}$  of gill filaments which are  $1\frac{1}{2}$  in eye.

Scales 31 to  $35+3$  or 4 in lateral line; 5 above, 3 below to ventral origin, 4 below to anal origin; 10 to 12 predorsal. Humeral extension triangular, extends 3 to  $3\frac{1}{2}$  in depressed pectoral. Caudal scaly over basal half. Ventral axil with pointed scaly flap  $2\frac{1}{4}$  to  $3\frac{1}{8}$  in fin. Lateral line complete, axial along side of body and reaches to middle of caudal basally.

D. II, 10, first branched ray  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in head; adipose fin  $4\frac{1}{4}$  to  $5\frac{3}{8}$ ; A. II, 6, second branched ray  $1\frac{3}{4}$  to 2; caudal  $1\frac{1}{2}$ , emarginate; least depth of caudal peduncle  $1\frac{3}{8}$  to  $2\frac{1}{8}$ ; pectoral  $1\frac{1}{2}$ , rays I, 12; ventral ray I, 7, fin length  $1\frac{3}{8}$  to  $1\frac{1}{2}$  in head.

Color in alcohol brown, little paler to whitish below. Lower side of head and humeral region with silvery white reflections. Iris white, with gray above. Mouth and lips pale or white like under surface of head. Occiput dark brown. Along and embracing lateral line a dark to blackish axial band, not wider than pupil, distinct from suprascapula to caudal and out over its middle rays to their hind ends. Above are 4 rows of scales with dark



blotch on each scale, also medial row of back, so that dark longitudinal streaks form. Five transverse dark bands cross back, though variable on 2 sides of body, as one at front of predorsal scalation, another midway in same, broader one from dorsal base, narrow one at end of depressed dorsal, broad one before adipose fin and last one on caudal peduncle before caudal base. Except as noted for the caudal, fins all uniformly pale, doubtless whitish in life.

A. N. S. P. no. 69467. Rio Jaguaribe, Russas, Ceará. 1936. Length 73 mm. Type.

A. N. S. P. no. 69468, same data. Length 70 mm. Paratype.

A. N. S. P. nos. 69469 to 69472. Campina Grande, Parahyba. 1936. Length 68 to 80 mm. Paratypes.

A. N. S. P. no. 69473. Rio Jaguaribe, Russas, Ceará. Length 82 mm. Paratype.

A. N. S. P. nos. 69474 to 69475. Açude Piloos, Parahyba. 1936. Length 56 to 57 mm. Paratypes.

Approaches *Apareiodon itapacuruensis* (Eigenmann and Henn) Eigenmann<sup>23</sup> which is described and figured with different coloration. The photographic figure shows but 2 dark lateral longitudinal bands. Its depth is shown as  $2\frac{1}{2}$ , while the description gives "4-4.5." The other lateral bands, evident in all my materials as described above, are not given. Variation of the scales arranged around the occiput is considerable, often the first scale of the predorsal series not reaching the occiput. Some of my specimens, gravid females, have the entire upper surface of the head and back covered with close-set minute "pearl organs" which are largest on the top of the head.

(For Mr. William Baldwin Davis, of Philadelphia, to whom I am indebted for many American fishes.)

#### PROCHILODINAE

##### PROCHILODUS Agassiz

*Prochilodus nigricans* Agassiz "Curimatã." Figure 81 (Fortaleza).

*Prochilodus nigricans* Agassiz, Sel. Gener. Spec. Pisc. Brasil, 1829, p. 64, pl. 39 (type locality, "Habitat in Brasiliae mediae fluvii").—Valenciennes, Hist. Nat. Poiss., vol. 22, 1849, p. (61) 80 (Amazon).—Günther, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 295 (part; not specimen); Ann. Mag. Nat. Hist., vol. 18, 1866, p. 30 (Upper Amazons).—Steindachner, Denks. Akad. Wiss. Wien, vol. 43, 1881, p. 132 (Obidos).—Fowler, Proc. Acad. Nat. Sci. Phila., 1915, p. 262 (R. Jaguaribe at Barro Alto, Brazil).

*Prochilodus nigricans* Starks, Fish. Stanford Exped. Brazil, 1913, p. 15 (Para; Madeira R.) (error).

*Pacus nigricans* Spix, in Agassiz, op. cit., p. 64 (name in synonymy).

<sup>23</sup> Ann. Carnegie Mus., vol. 10, nos. 1-2, art. 5, Jan. 31, 1916, p. 72, pl. 11, fig. 2 (photograph) (type locality, "Rio Paiaia, tributary of the Rio Itapicuru; Queimadas; Timbo; Rio Aqua Branca").

Depth  $2\frac{3}{4}$  to  $2\frac{5}{8}$ ; head  $3\frac{3}{8}$  to  $3\frac{5}{8}$ , width  $1\frac{1}{2}$  to  $1\frac{3}{4}$ . Snout (in profile) 3 to  $3\frac{1}{2}$  in head; eye  $4\frac{1}{2}$  to  $5\frac{1}{2}$ ,  $1\frac{1}{2}$  in snout,  $3\frac{1}{2}$  in interorbital; maxillary  $3\frac{3}{8}$  to  $4\frac{1}{2}$  in head; mouth width  $2\frac{1}{2}$  to 3, lower jaw slightly shorter; edges of lips with single series of small, compressed, equal, closely set, firm teeth, and anteriorly in each jaw short inner series; interorbital  $1\frac{1}{2}$  to  $2\frac{1}{10}$ , broadly convex. Gill rakers 15+25, short fleshy points,  $\frac{1}{4}$  of gill filaments, which are  $\frac{1}{2}$  of eye.

Scales 41 to 43+4 in lateral line; 9 or 10 above, 7 or 8 below to ventral origin, 7 or 8 below to anal origin; 16 predorsal. Small scales on caudal and anal bases, fins otherwise naked. Pointed axillary scale 3 in fin. Lateral line complete, axial along side of body, small simple tubes well exposed.

D. III, 9, 1, first branched ray  $1\frac{1}{10}$  to  $1\frac{1}{2}$  in head; adipose fin  $1\frac{1}{2}$  in eye; A. III, 9, first branched ray  $1\frac{1}{2}$ ; caudal well forked; least depth of caudal peduncle  $2\frac{1}{10}$  to  $2\frac{1}{2}$  in head; pectoral  $1\frac{1}{2}$  to  $1\frac{3}{4}$ , rays I, 14; ventral rays I, 8, fin  $2\frac{1}{10}$  to  $2\frac{1}{2}$  in head.

Color in alcohol brownish above, paler to whitish below, where nearly immaculate. At junction of each series of scales on side of body a narrow brownish longitudinal line, on back dark, though on lower surface of body lines indistinct or fading out. Back and sides with 16 transverse dark brown streaks, most conspicuous above and fading out below. Fins all with rather pale general color, dorsal, caudal and anal spotted with grayish dusky. Iris dark gray. Opercle with brownish blotch.

Two, 118 to 124 mm., Bodocongó, Campina Grande, Parahyba. 1936.

One, 311 mm., Rio Parnahyba, Therezina, Piahy. 1936.

Four, 80 to 117 mm., Forteleza, Ceará. 1937.

**Prochilodus corimbata** (Kner) "Curimatã." Figure 82 (Lago Papary).

*Salmo corimbata* (Natterer) Kner, Denks. Akad. Wiss. Wien, vol. 17, 1859, p. 146 ("Natterer bezeichnet diese Art als *Salmo corimbata*").

*Prochilodus nigricans* (not Agassiz) Kner, op. cit., p. 146 (type locality, Ypanema, Brazil).

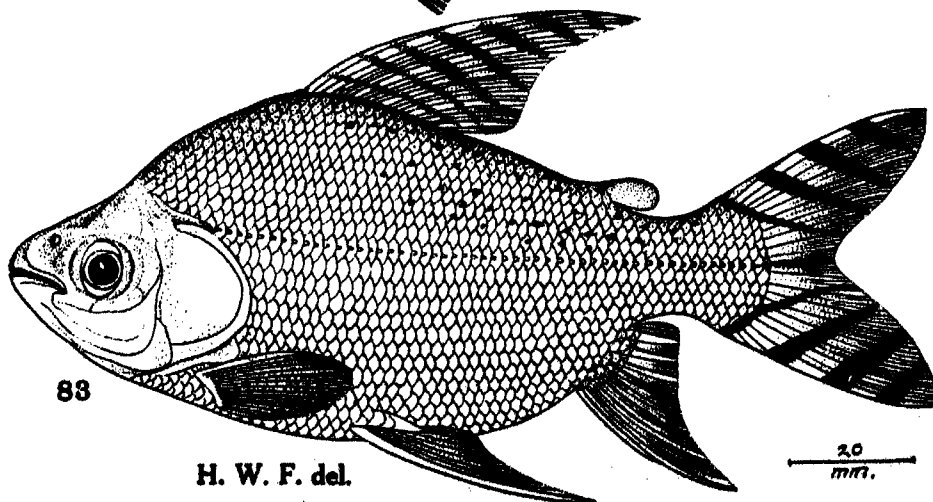
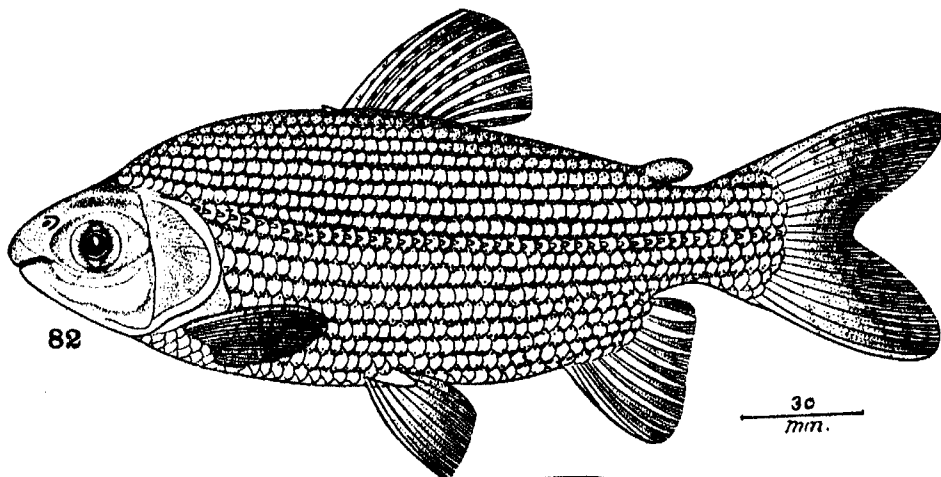
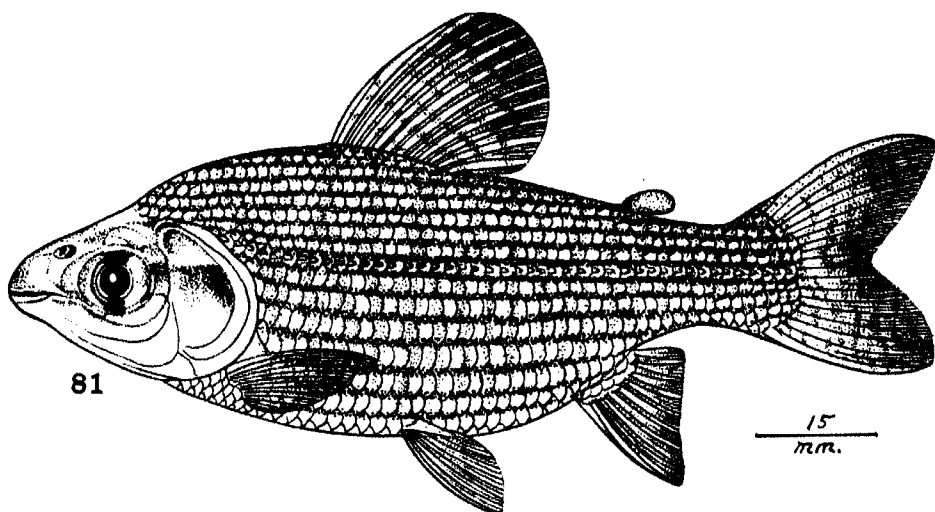
*Prochilodus oligolepis* Günther, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 295 (on Kner).—Steindachner, Denks. Akad. Wiss. Wien, vol. 43, 1882, p. 133 (Natterer's material).

Depth  $2\frac{3}{4}$  to  $3\frac{1}{2}$ ; head  $3\frac{1}{2}$  to 4, width  $1\frac{1}{2}$  to  $1\frac{3}{4}$ . Snout (in profile)  $2\frac{1}{2}$  to 3 in head; eye  $5\frac{1}{2}$  to 6,  $1\frac{1}{2}$  to 2 in snout, 3 to  $3\frac{1}{2}$  in interorbital; maxillary reaches  $\frac{2}{3}$  to eye, length  $3\frac{1}{2}$  to 4 in head; mouth width  $2\frac{1}{2}$  to  $2\frac{3}{4}$ , lower jaw shorter; lips broad, fleshy; teeth very minute; interorbital  $1\frac{1}{2}$  to  $1\frac{3}{4}$ , broadly convex; infraorbitals cover  $\frac{2}{3}$  of cheek. Gill rakers 22+30, short, flexible, tentacle-like points,  $\frac{1}{2}$  of gill filaments, which are subequal with eye.

Scales 34 to 39+3 or 4 in lateral line; 8 above, 7 below to ventral origin, 7 or 8 below to anal origin; 16 or 17 predorsal extend forward opposite middle of eye. Axillary ventral scale 3 to  $3\frac{3}{8}$  in fin. Anal with basal scaly sheath of rather small scales. Tubes in lateral line simple, well exposed.

D. III, 8, 1, first branched ray  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in head; adipose fin  $1\frac{1}{2}$  times eye; A. III, 8, 1, first branched ray 2 in head; caudal 1 to  $1\frac{1}{10}$  times head, deeply forked; least depth of caudal peduncle 2 to  $2\frac{1}{2}$  in head; pectoral  $1\frac{1}{2}$  to  $1\frac{3}{4}$ , rays I, 13; ventral rays I, 8, fin  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in head.

Color in alcohol largely uniform brown, each scale with paler median area. Eye brown. Lower surfaces scarcely paler than back. Fins pale or



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Explanation at bottom of page 171.

dull brown. Dorsal with last half of fin with 4 to 8 dark spots on each ray. Caudal with 5 or 6 dark to blackish transverse bands, variable, more or less broken as spots and resulting in last one parallel with hind edge of caudal. Anal with membrane largely blackish brown. Pectoral dull brown. Ventral with some dark to blackish dots on fin terminally.

Three, 165 to 185 mm., Lago Papary, Rio Grande do Norte. 1936. All show a rather dark longitudinal line or band at junctures of scales, both above and below lateral line.

Two, 230 to 285 mm., Lago Papary, also 1936.

Two, 253 to 325 mm., Forteleza, Ceará. 1936. Larger female full of roe.

One, 290 mm., Campina Grande, Parahyba.

*Prochilodus hartii* Steindachner<sup>24</sup> is described and figured with: Depth  $3\frac{1}{2}$ ; head 4; scales 41+42 in lateral line, 6 or 7 above, 6 below; D. III, 9; A. III, 8, 1; membrane of dorsal with dark spots, all other fins shown immaculate.

*Prochilodus cearaensis* Steindachner<sup>25</sup> is closely related if not the same. It has the following: Depth  $2\frac{1}{2}$  to 3; head width  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in its length; snout  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in head; eye  $4\frac{1}{2}$  to  $4\frac{3}{4}$ ; interorbital 2; mouth width  $2\frac{1}{2}$  to  $2\frac{3}{4}$ . Scales 40 or 41, of which 3 on caudal, in lateral line; 8 above, 6 or 7 below to ventral; 17 predorsal. D. II, 10; A. II, 9; dorsal and caudal flaked with dark gray; flakes banded on upper caudal lobe in 10 cross rows. Length 166 to 186 mm.

***Prochilodus steindachneri* Fowler** "Curimatã."

*Prochilodus steindachneri* Fowler, Proc. Acad. Nat. Sci. Phila., July 26, 1906, p. 309, fig. 11 (type locality, Parahyba, Brazil).

One, 113 mm., Rio Salgade, Icó, Ceará. 1937.

Four, 93 to 123 mm., Rio São Francisco, Jatobá, Pernambuco. 1936.

#### SEMAPROCHILODUS new genus

TYPE.—*Prochilodus squamilentus* new species.

Body well compressed, deeply ovoid. Head large, compressed. Snout short, broad, obtuse. Eye large, in front half of head, with broad adipose lids. Mouth large, nearly horizontal, reaches front of eye, jaws nearly equal or lower but little shorter. Each lip with row of small, uniform, close-set, very short, simple, compressed, pointed movable teeth. Nostrils small, closely set, on upper surface of snout, rather close before eye. Infra-orbitals narrow, leave broad naked cheek. Interorbital convex, wide. Frontal fontanel well developed, reaches into occipital extension. Gill opening moderate, laterally restricted. Gill rakers very short, weak, minute points. Scales small, in even longitudinal series, many with few short marginal

<sup>24</sup> Sitzb. Akad. Wiss. Wien, vol. 70, pt. 1, 1874, p. 533, pl. 5 (type locality, "Rio Jequitinhonha, Rio pardo und Rio Parahyba").

<sup>25</sup> Anzeiger Akad. Wiss. Wien, vol. 48, nr. 15, 1911, p. 329 (type locality "aus einem kleinen Flüsschen bei Ipu im Staate Ceara").

FIG. 81.—*Prochilodus nigricans* Agassiz. FIG. 82.—*Prochilodus corimbata* (Kner). FIG. 83.—*Semaprochilodus squamilentus* new species.

denticles. Dorsal and anal each with moderate basal sheath. Caudal base scaled. Ventral with pointed axillary scale. Humeral extension short. Lateral line complete, axial, straight, tubes simple, extend back on caudal base to hind end of scalation. Dorsal very large, elongated front rays reaching into adipose fin, preceded basally by short forked movable antrorse spine. Anal moderate, front rays extended. Caudal large, deeply forked. Pectoral low, moderate. Ventrals long, front rays extended.

Distinguished from *Prochilodus* chiefly by its long falcate dorsal and ventral fins, also the black banded dorsal and caudal fins and comparatively deep body, as well as its distinctive facies.

(*orqua* banner + *Prochilodus*.)

**Semaprochilodus squamilentus** new species

Figure 83.

Depth 2 to  $2\frac{1}{2}$ ; head  $2\frac{3}{4}$  to 3, width  $1\frac{1}{2}$  to 2. Snout (in profile)  $3\frac{1}{2}$  to 4 in head; eye  $3\frac{3}{4}$  to 4, subequal with snout,  $1\frac{1}{2}$  to  $1\frac{1}{4}$  in interorbital, adipose lids broadly invade iris; mouth broad, width  $2\frac{2}{3}$  to  $2\frac{1}{2}$  in head; interorbital 2 to  $2\frac{1}{2}$ , convex; opercle smooth, with only obsolete striae. Gill rakers 12+25, very short simple points,  $\frac{1}{2}$  of gill filaments, which are  $1\frac{1}{2}$  in eye.

Scales 50 to 53+ 4 or 5 in lateral line; 13 above, 13 below to ventral origin, 11 or 12 below to anal origin; 15 to 17 predorsal forward to occipital point. Axillary ventral scale 2 to  $3\frac{1}{2}$  in fin. Postventral with strong compressed scaly keel to vent. Short humeral extension  $3\frac{1}{2}$  to  $4\frac{1}{2}$  in depressed pectoral.

D. III, 9, first branched ray  $2\frac{1}{2}$  to  $2\frac{1}{4}$  in fish without caudal; adipose fin  $3\frac{1}{2}$  to  $4\frac{1}{2}$  in head; A. III, 8, first branched ray  $1\frac{1}{2}$ ; caudal  $2\frac{3}{4}$  in rest of fish, deeply forked; least depth of caudal peduncle  $2\frac{3}{4}$  in head; pectoral  $1\frac{1}{2}$ , rays I, 15; ventral rays I, 8, fin  $1\frac{1}{2}$  in head to  $2\frac{3}{4}$  in fish without caudal.

Color in alcohol brown above, paler to whitish below and behind dorsal scattered small blackish spots. Dorsal with 8 horizontal blackish bands. Anal pale to whitish, with first, third and fifth membranes before branched rays little dark gray terminally. Caudal pale yellowish, with median black horizontal band, and each lobe with 4 inclined transverse black bands, outermost, especially below, broader terminally on fin. Paired fins uniformly pale to whitish.

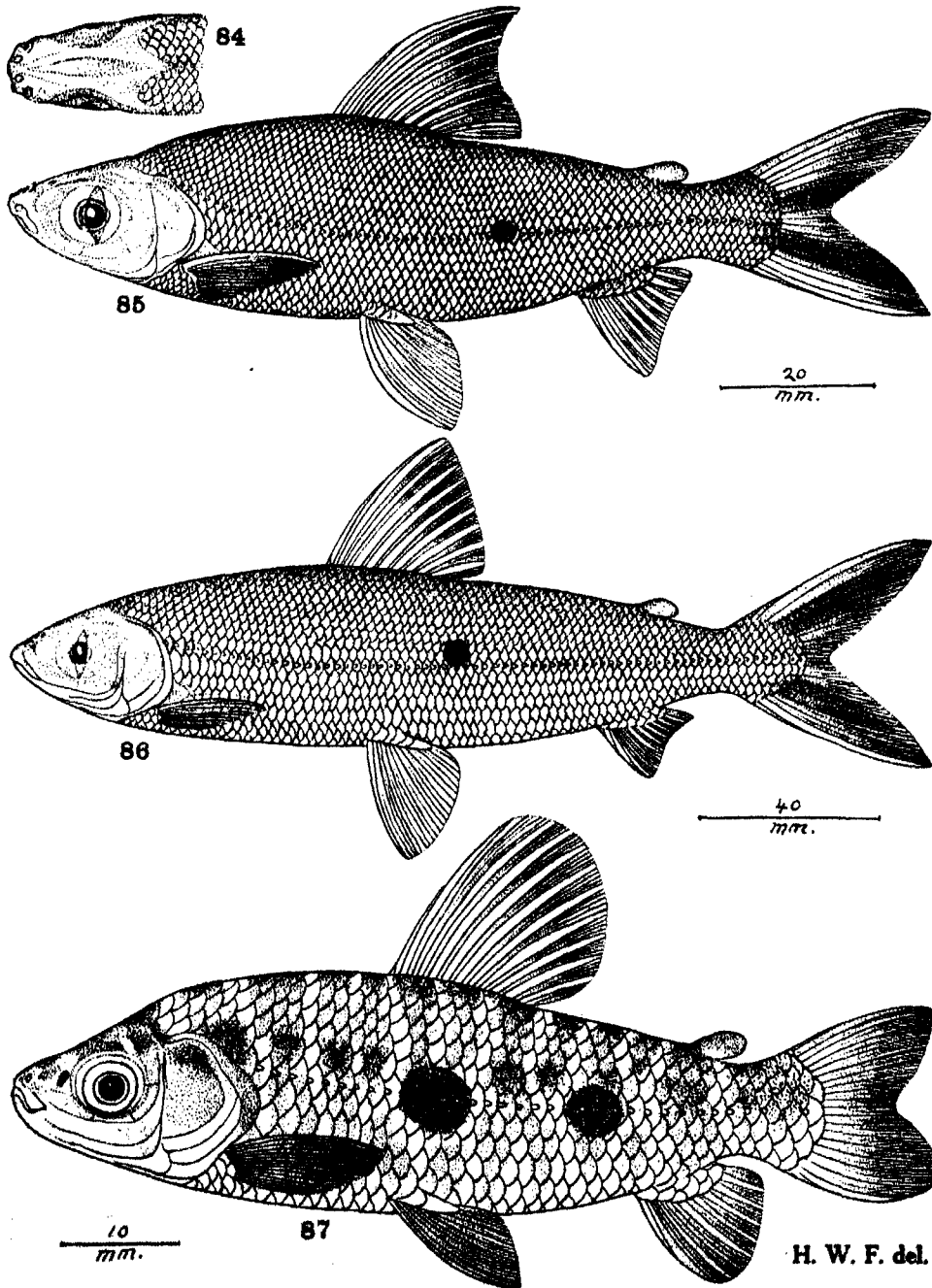
A.N.S.P. no. 69480. Rio Parnahyba, Therezina, Piahy. 1936. Length 160 mm. Type.

A.N.S.P. no. 69481, same data, paratype. Length 152 mm.

I feel unable to identify this species with the imperfectly described and figured *Prochilodus insignis* Schomburgk,<sup>26</sup> altogether different in proportions and scalation, and especially in the coloration of its caudal, which is shown with a black median or horizontal band besides 5 black inclined transverse bands on each caudal lobe. Other authors<sup>27</sup> have listed mater-

<sup>26</sup> Fishes of British Guiana, pt. 1, vol. 1, 1841, p. 261, pl. (type locality, Rio Branco).

<sup>27</sup> Kner, Denks. Akad. Wiss. Wien, vol. 17, 1859, p. 147 (Rio Negro).—Günther, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 296 (Santarem).—Eigenmann and Ogle, Proc. U. S. Nat. Mus., vol. 33, Sept. 10, 1907, p. 5 (Bolivia).



FIGS. 84 and 85.—*Hemiodus rodolphoi* new species. FIG. 86.—*Anisitsia notata* (Schomburgk). FIG. 87.—*Leporinus piau* new species.

ials under the same name, but it would appear doubtful if they are really the same. Kner and Günther give the scales 46 in the lateral line, and 9 or 10 above and 10 or 11 below, much larger than in *Semaprochilodus squamilentus*. They therefore appear to represent *Semaprochilodus amazonensis* (Fowler).<sup>28</sup>

(*Squamilentus* small-scaled.)

#### HEMIODONTINAE

**Hemiodus rodolphoi** new species

Figures 84 (head above) and 85.

Depth  $3\frac{1}{2}$  to  $3\frac{3}{4}$ ; head  $3\frac{3}{4}$  to  $3\frac{5}{8}$ , width 2 to  $2\frac{1}{4}$ . Snout (in profile) 4 in head; eye  $3\frac{1}{4}$  to  $3\frac{3}{8}$ , slightly greater to subequal with snout or interorbital; broad adipose lids largely covering iris; above and behind snout end 2 small bony knobs, and on each side of upper jaw and more widely set another similar pair; maxillary reaches  $\frac{3}{4}$  to eye, sheathed above by preorbital; upper jaw with 20 compressed denticulated incisors, series continued each side with 6 smaller similar teeth on each maxillary; mandible very shallow, depressed, with curved entire trenchant edge all around; interorbital  $3\frac{1}{4}$  to  $3\frac{3}{4}$  in head, convex; suborbitals broad, entirely cover cheek. Gill opening moderate, extends forward opposite middle of eye. Gill rakers  $20+36?$  short, close-set, slender points,  $\frac{1}{2}$  of gill filaments, which are  $1\frac{3}{4}$  in eye.

Scales 60 to 65+5 or 6 in lateral line; 17 or 18 above, 11 below to ventral origin, 10 below to anal origin; 23 to 25 predorsal forward to occipital angle. Caudal base scaly. Anal with basal scaly sheath. Humeral extension  $3\frac{3}{4}$  in depressed pectoral. Axillary ventral scale  $2\frac{3}{4}$  to  $2\frac{5}{8}$  in fin. Lateral line little decurved, becomes median along side of caudal peduncle and out on basal caudal sculation, small tubes simple.

D. III, 9, first branched ray 1 in head; adipose fin  $3\frac{1}{2}$  to  $3\frac{3}{4}$ ; A. III, 9, first branched ray  $1\frac{1}{4}$  to 2; caudal 3 to  $3\frac{1}{4}$  in rest of fish, deeply forked, lobes equal; least depth of caudal peduncle  $2\frac{3}{4}$  to 3 in head; pectoral  $1\frac{1}{4}$  to  $1\frac{3}{4}$ , rays I, 16; ventral rays I, 10, fin  $1\frac{1}{4}$  to  $1\frac{1}{2}$  in head.

Color in alcohol brown, paler below. On lateral line opposite terminal portion of depressed dorsal small round black spot, subequal in size with pupil. Iris pale, evidently white. Fins all pale except caudal, which with an inner longitudinal dark band each side of confluence of lobes, lower blackish and neither appearing to reach fin edge. Fins otherwise all uniformly pale.

A.N.S.P. no. 69483. Rio Parnahyba, Therezina, Piahy. 1936. Length 127 mm. Type.

A.N.S.P. no. 69484, same data, paratype. Length 115 mm.

A.N.S.P. nos. 69485 to 69488. Forteleza, Ceará. 1937. Length 118 to 135 mm. Paratypes. In rather poor preservation. Color quite pale, with lower half of body and eyes silvery white. In some each inner submargin of the lobe of the caudal with a brown line extending from the 2 dark or inner black bands of the fin.

<sup>28</sup> *Prochilodus amazonensis* Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, Feb. 20, 1940, p. 260 (Boca Chica, Peru).

Related to *Hemiodus longiceps* Kner,<sup>29</sup> differing in color, as each lobe with a black band submarginally from bases of median rays, superiorly and inferiorly. *Hemiodus longiceps* is described by Kner with "Die Caudale ist hell gesäumt, all Flossen sind ungeflecht" from specimens 205 to 230 mm. long. Günther describes a specimen from the Rio Capin with the "Inter-radial membrane of the dorsal fin, and a large blotch in the fork of the caudal fin black." Kner gives 77 to 79 scales in the lateral line, his figure showing 13 above to dorsal, 7 below to ventral origin and 7 below to anal origin.

A quite differently colored species, with smaller scales 80 to 83 in the lateral line has been reported from Parnagua by Eigenmann and Henn as *Hemiodus parnaguae*.<sup>30</sup>

(For the late Dr. Rodolpho von Ihering.)

**Anisitsia notata** (Schomburgk)

Figure 86.

*Anodus? notatus* Schomburgk, Fish. Brit. Guiana, vol. 1, 1841, p. 218, pl. 15 (type locality, Rio Negro).

*Anisitsia notata* Eigenmann, Mem. Carnegie Mus., vol. 5, June 1912, p. 277 (British Guiana).—Fowler, Proc. Acad. Nat. Sci. Phila., 1914, p. 233 (Rupununi R.).

Two, 177 to 196 mm., Rio Parnahyba, Therezina, Piauhy. 1936.

*Hemiodus kappleri* Günther<sup>31</sup> is evidently an *Anisitsia*.

#### CHILODINAE

**Chilodus labyrinthicus** (Kner) "Casca grossa."

*Microdus labyrinthicus* Kner, Denks. Akad. Wiss. Wien, vol. 17, 1859, p. 149, pl. 3, fig. 5 (type locality, "Rio branco und Barro do Rio negro").

*Caenotropus labyrinthicus* Günther, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 297 (Rio Capin).

One, 136 mm. to end of broken caudal, Rio Parnahyba, Piauhy. 1936.

#### ANOSTOMATINAE

**Schizodon fasciatus** Agassiz

*Schizodon fasciatus* Agassiz, Select. Gen. Spec. Pisc. Brasil, 1829, p. 66 (type locality, "in Brasiliae fluvius").—Eigenmann, Mem. Carnegie Mus., vol. 5, June 1912, p. 297 (Rupununi Pan; Twoca Pan, British Guiana).—Fowler, Proc. Acad. Nat. Sci. Phila., May 29, 1914, p. 242 (Rupununi R.); vol. 91, 1939 (Feb. 20, 1940), p. 261 (Condamana, Peru).

*Curimata fasciatus* (Spix) Agassiz, op. cit., p. 66, pl. 36 (name in text).

Four, 40 to 80 mm., Rio Jaguaribe, Russas, Ceará. Anal blackish. An obscure dark axial lateral streak, with 5 large blackish blotches nearly equidistant along its course. Hind caudal edge rather dark gray, fins otherwise pale or uniform.

<sup>29</sup> Denks. Akad. Wiss. Wien, vol. 17, 1859, p. 152, pl. 3, fig. 6 (type locality, Rio Icanno).—Günther, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 300 (Rio Capin).

<sup>30</sup> Ann. Carnegie Mus., vol. 10, nos. 1-2, Jan. 31, 1916, p. 87, pl. 17 (type locality, Lagoa de Parnagua).

<sup>31</sup> Proc. Zool. Soc. London, March 26, 1868, p. 244 (type locality, Surinam).



**Leporinus friderici** (Bloch)

"Piau."

*Salmo friderici* Bloch, Naturg. Ausl. Fische, pt. 8, 1794, p. 94, pl. 378 (type locality, Surinam).

*Leporinus friderici* Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 261 (Contamana, Peru).

Depth  $3\frac{1}{2}$  to  $3\frac{3}{4}$ ; head  $3\frac{1}{4}$  to  $3\frac{1}{2}$ , width  $1\frac{1}{4}$  to  $1\frac{1}{2}$ . Snout (in profile)  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in head; eye  $3\frac{1}{2}$  to 5,  $1\frac{1}{4}$  to  $1\frac{1}{2}$  in snout,  $1\frac{1}{2}$  to  $2\frac{1}{2}$  in interorbital; maxillary reaches half way to eye, length 4 to 5 in head; mouth broad, jaws subequal, width  $3\frac{1}{2}$  to 4 in head; lips fleshy, papillate; 8 teeth in each jaw, graduated smaller backwards, edges of upper obtusely convex and edges of lower larger ones moderately emarginate or notched; interorbital 2 to  $2\frac{1}{2}$  in head, broadly convex; suborbitals narrow, cover  $\frac{1}{2}$  of cheek to preopercle ridge. Gill opening lateral, exposes broad convex isthmus, with rather broad cutaneous margin.

Scales 30+4 in lateral line; 4 above, 5 below to ventral origin, 5 below to anal origin; 11 predorsal. Ventral with pointed axillary scale 2 in fin. Row of 5 basal scales each side forming basal sheath to anal.

D. III, 9 or 10, first branched ray  $1\frac{1}{2}$  in head; adipose fin nearly long as snout in profile; A. II, 8, second branched ray  $1\frac{1}{2}$  to  $1\frac{1}{4}$  in head; caudal (damaged)  $1\frac{1}{10}$  to  $1\frac{1}{2}$ , emarginate; least depth of caudal peduncle  $2\frac{1}{2}$  to  $2\frac{3}{4}$ ; pectoral  $1\frac{1}{2}$  to  $1\frac{1}{4}$ , rays I, 14; ventral rays I, 8, fin  $1\frac{1}{2}$ .

Color in alcohol largely uniform dark brown, probably stained in preservation. On lateral line from 13 to 15 scales and 1 scale above and another below, large black blotch (on right side from 11 to 15 scales in lateral line); another smaller blackish blotch on 22 and 23 scales of lateral line, besides traces of third at caudal base. Marginal membrane of gill opening paler or light brown. Iris brown. Dorsal, adipose fin and caudal uniform brown. Anal brownish, each membrane dark gray medially. Paired fins uniformly brown.

Three, 102 to 162 mm., Lago Papary, Rio Grande do Norte. 1936.

Four, 90 to 104 mm., Rio Parnahyba, Therezina, Piahy. 1936.

**Leporinus piau** new species

"Piaus", "Piau verdadeiro."

Figure 87.

Depth  $3\frac{1}{2}$  to  $3\frac{3}{4}$ ; head  $2\frac{1}{2}$  to 3, width  $1\frac{1}{2}$  to  $2\frac{1}{4}$ . Snout (in profile) 3 to  $3\frac{1}{2}$  in head; eye  $3\frac{1}{2}$  to  $4\frac{1}{2}$ ,  $1\frac{1}{2}$  to  $1\frac{1}{4}$  in snout,  $1\frac{1}{2}$  to 2 in interorbital, with narrow marginal free adipose border little invading iris; maxillary reaches  $\frac{1}{2}$  to  $\frac{3}{4}$  to eye, length  $4\frac{1}{2}$  to  $5\frac{1}{2}$  in head; mouth cleft very short, level with middle of eye, jaws subequal; lips rather thick and fleshy; 6 teeth above, 4 below, in jaws, with front pair of each largest, compressed, pointed; interorbital  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in head, broadly convex; infraorbitals narrow, cover  $\frac{1}{2}$  to  $\frac{3}{4}$  of cheek. Gill opening lateral, extends forward opposite vertical margin of preopercle. Gill rakers 11+14, short points  $\frac{1}{2}$  of gill filaments, which are  $1\frac{1}{2}$  in eye.

Scales 32+3 or 4 in lateral line; 5 above, 5 below to ventral origin, 5 below to anal origin; 12 predorsal forward until little behind hind eye edge. Caudal and anal bases scaly, though forming sheath on latter moderately. Humeral extension reaches  $\frac{1}{2}$  in depressed pectoral. Ventral with pointed axillary scales,  $2\frac{1}{4}$  in fin. Lateral line complete, axial along side of body, tubes small and short in scale exposures.

D. III, 10, first branched ray  $1\frac{1}{2}$  to  $1\frac{1}{4}$  in head; adipose fin  $4\frac{1}{2}$  to 5; A. III, 8, second branched ray 2 to  $2\frac{1}{2}$ ; caudal  $1\frac{1}{2}$  to  $1\frac{1}{4}$ , little emarginate be-

hind; least depth of caudal peduncle  $2\frac{3}{4}$  to  $2\frac{3}{4}$ ; pectoral  $1\frac{1}{2}$  to 2, rays I, 14; ventral rays I, 8, fin  $1\frac{1}{2}$  to  $1\frac{1}{2}$  in head.

Color in alcohol brown, little paler to whitish below. On body 16 transverse blackish variable bands, in young as pairs mostly fused above or before crossing lateral line so as to form 8 transverse lateral bands, with fourth or sixth on lateral line emphasized, each as large black blotches. Iris dark gray. Fins all more or less pale grayish, especially dorsal, caudal and pectoral. Anal dark gray. Ventral specked or dotted with dark gray or brown medially, leaving borders paler.

A.N.S.P. no. 69502. Rio Salgade, Icó, Ceará. 1937. Length 85 mm. Type.

A.N.S.P. nos. 69503 to 69508. Jatobá, Rio São Francisco, Pernambuco. Length 40 to 58 mm. Paratypes.

A.N.S.P. no. 69509. Rio Jaguaribe, Orós, Ceará. 1937. Length 120 mm. Paratype.

Related to *Leporinus maculatus* (Müller and Troschel) but differing entirely in coloration. The black spot on the adipose fin I have noticed in no other species. The short caudal is half scaled basally.

(*Piau* the native name.)

***Leporinus crassilabris* Borodin**

*Leporinus crassilabris* Borodin, Mem. Mus. Comp. Zool., vol. 50, no. 3, April 1929, p. 274, text fig. 1 (head of adult), pl. 4 (type locality, Rio Jaquitinhonha, Brazil).

One, 94 mm., Forteleza, Ceará. Agrees in most every way with Borodin's figure in its color pattern.

***Leporinus agassizii* Steindachner**

*Leporinus agassizii* Steindachner, Sitzsb. Akad. Wiss. Wien, vol. 74, pt. 1, 1876, p. 107, pl. 9, fig. 4 (type locality, "Amazonenstrom bei Tabatinga und Tefte; Rio Iça").

One, 54 mm., Rio Jaguaribe, Russas, Ceará. 1936.

***Leporinus melanopleura* Günther "Piaus."**

Figure 88.

*Leporinus melanopleura* Günther, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 310 (type locality, Bahia; Cipo River).

One, 134 mm., Rio Salgade, Icó, Ceará. 1937.

Nine, 103 to 168 mm., Rio Jaguaribe, Orós, Ceará. 1937.

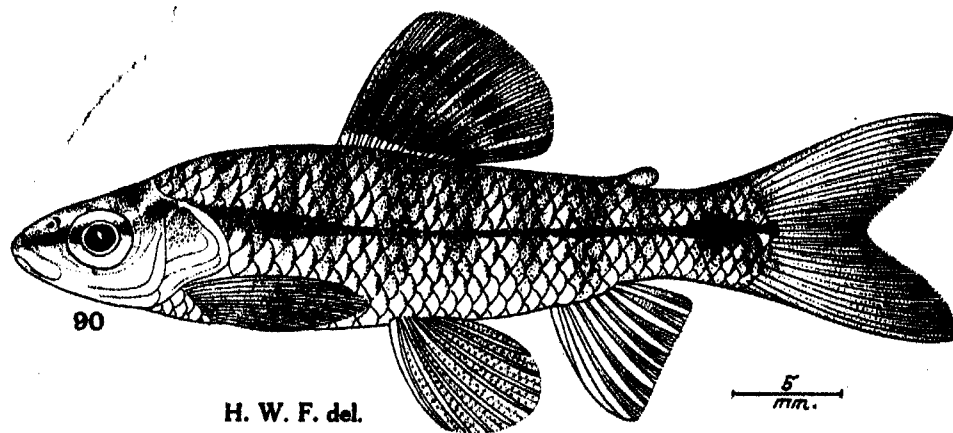
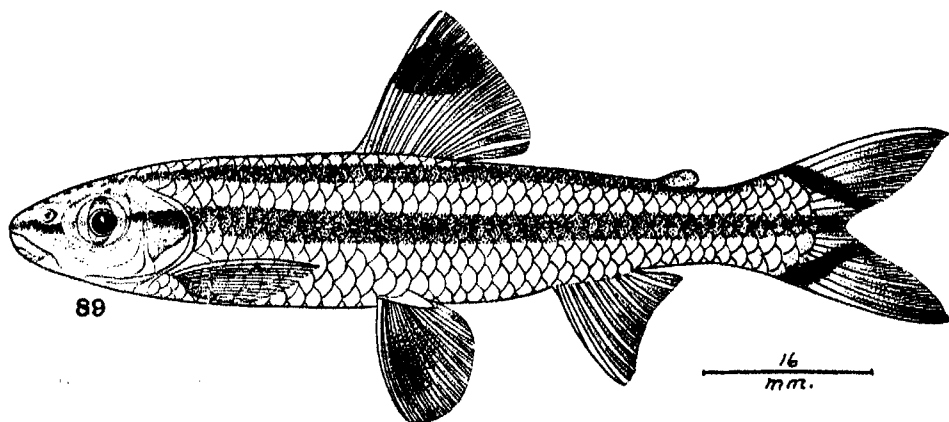
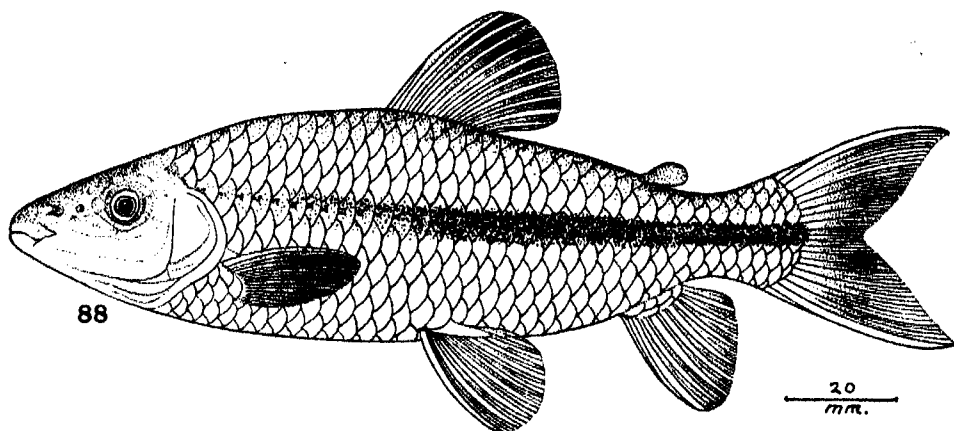
These materials show scales 33 to 37 in the lateral line, and 4 or 5 above.

LEPORELLINAE

***Leporellus cartledgei* new species "Charuto."**

Figure 89.

Depth 5; head 4, width 2. Snout (in profile) 3 in head; eye 4,  $1\frac{1}{2}$  in snout,  $1\frac{1}{2}$  in interorbital, broad adipose lids well covering iris; maxillary reaches  $\frac{1}{2}$  to eye, length  $4\frac{1}{2}$  in head; mouth cleft short, little inclined from horizontal, close below level of lower eye edge and lower jaw shorter or included in upper; 6 incisors in each jaw, with front median pair little largest and with edges of each tooth little notched; interorbital 3 in head, little



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FIG. 88.—*Leporinus melanopleura* Günther.

FIG. 89.—*Leporellus cartledgei* new species.

FIG. 90.—*Characidium bimaculatum* new species.

elevated, convex; suborbitals moderate, anteriorly cover  $\frac{1}{4}$  of cheek, posteriorly about  $\frac{3}{8}$ . Gill opening lateral, extends forward opposite hind edge of preopercle. Gill rakers 10+13, short points,  $\frac{1}{4}$  of gill filaments, which are  $1\frac{1}{2}$  in eye.

Scales 35+4 in lateral line; 5 above, 4 below to ventral origin, 4 below to anal origin, 12 predorsal forward to end of occipital extension. Caudal with basal  $\frac{2}{3}$  scaly and with scales much smaller than on body. Humeral extension  $\frac{1}{2}$  length of depressed pectoral. Pointed scale in ventral axil  $2\frac{1}{2}$  in fin. Lateral line complete, axial along side of body, with small, short and little prominent little tubes.

D. III, 10, first branched ray  $1\frac{1}{2}$  in head; adipose fin 4; A. III, 8, first branched ray  $1\frac{1}{2}$ ; caudal  $3\frac{1}{2}$  in rest of fish, fin deeply forked; least depth of caudal peduncle  $2\frac{1}{2}$  in head; pectoral  $1\frac{1}{2}$ , rays I, 12; ventral rays I, 8, fin  $1\frac{1}{2}$  in head.

Color in alcohol brownish, paler below and apparently much more so in life. Top of head with scattered, variable, obscure, dark spots. On predorsal 2 dark or blackish parallel close-set narrow bands forward to occiput. On each side of back broader dark band, lower, and back to adipose fin and origin of upper caudal lobe. Blackish medial lateral band from side of snout end, through eye, over postocular region and embracing lateral line to caudal basally. Fins all pale. Dorsal with large subterminal blackish blotch, much larger than eye. Caudal with transverse black bar on each lobe, besides median extension of blackish lateral band from body over median rays.

A. N. S. P. no. 69522. Penedo, Rio São Francisco, Pernambuco. 1936. Length 90 mm. Type.

Only the type obtained. Greatly like *Leporinus pictus* Kner,<sup>32</sup> which is synonymous with *Leporinus vittatus* Valenciennes, the genotype of *Leporellus* Lütken. Its pattern of coloration is greatly similar, though that species is indicated according to Kner's figure with the depth  $3\frac{1}{2}$ , five scales below the lateral line to the ventral origin and the pectoral shorter.

(For Prof. Franklin Fisher Cartledge, of Philadelphia, to whom I am indebted for many local fishes.)

#### NANNOSTOMATINAE

*Characidium bimaculatum* new species

Figure 90.

Depth  $3\frac{1}{2}$  to 4; head 3 to  $3\frac{1}{4}$ , width 2 to  $2\frac{1}{4}$ . Snout (in profile)  $3\frac{1}{2}$  to 4 in head; eye 3 to  $3\frac{3}{4}$ , greater than snout, subequal with interorbital; maxillary reaches nearly or quite opposite front eye edge, length  $3\frac{3}{4}$  to 4 in head; mouth short, small, level with lower edge of eye; lips smooth, thin, entire; teeth very small, minute, uniform, in single row in each jaw; interorbital  $2\frac{1}{2}$  to  $3\frac{3}{4}$  in head, low, convex; suborbitals narrow, occupy  $\frac{1}{3}$  of cheek, postoculars broader. Gill opening extends forward opposite center of eye. Gill rakers 3+6, short weak points,  $\frac{1}{4}$  of gill filaments which are  $1\frac{1}{2}$  in eye.

Scales 31 or 32+2 or 3 in axial lateral series; 10 transversely between dorsal and ventral origins; 10 to 12 predorsal forward to occipital extension.

<sup>32</sup> Denks. Akad. Wiss. Wien, vol. 17, 1859, p. 172, pl. 8, fig. 19 (type locality, Irisanga).

Caudal base scaly. Humeral extension short,  $\frac{2}{3}$  in length of depressed pectoral. Lateral line not evident. Each ventral ray with 1 or 2 rows of minute contact denticles.

D. II, 10, second branched ray  $1\frac{1}{2}$  to  $1\frac{1}{4}$  in head; adipose fin  $4\frac{1}{2}$  to  $5\frac{3}{4}$ ; A. III, 7, first branched ray  $1\frac{1}{2}$  to  $1\frac{3}{4}$ ; caudal  $2\frac{1}{2}$  to  $3\frac{1}{4}$  in rest of fish, forked, lobes equal; least depth of caudal peduncle  $2\frac{3}{4}$  to  $2\frac{1}{2}$  in head; pectoral  $1\frac{1}{2}$  to  $1\frac{1}{4}$ , rays I, 11; ventral rays I, 8, fin  $1\frac{1}{2}$  to  $1\frac{1}{4}$  in head.

Color in alcohol pale or light brownish, still paler to whitish below. On body 14 transverse darker bands, usually emphasized as dark borders to scales, as 4 on predorsal, 3 below dorsal, 3 behind dorsal before adipose fin, 1 below adipose fin, 2 on caudal peduncle and 1 on caudal base. Blackish lateral band, first as bar on side of snout, expanded behind suprascapula or above pectoral, and again at caudal base where it terminates in a small short bar at end of caudal scalation. Iris dark gray. Dorsal with all rays blackish subbasally and less intense over rays until subterminal where fading out. Otherwise all fins largely gray.

A.N.S.P. no. 69523. Forteleza, Ceará. 1937. Length 43 mm. Type.

A.N.S.P. nos. 69524 to 69528, same data, paratypes. Length 29 to 40 mm.

Apparently related to *Characidium fasciatus* Reinhardt, but differing in the broad black subbasal blotch or band on the dorsal, and the large oval black blotch embracing the dark lateral band at the caudal peduncle and caudal base.

(bis twice + macula spot.)

#### CHEIRODONTINAE

##### *Cheirodon piaba* Lütken

*Chirodon piaba* Lütken, Oefvers. Dansk. Selsk. Kjöbenhavn, no. 3, 1874, p. 134 (type locality, Rio das Velhas); K. Dansk. Vid. Selsk. Skrift., ser. 5, vol. 12, 1880, p. 219, text fig., p. xiv (Rio das Velhas).

*Cheirodon piaba* Eigenmann, Mem. Carnegie Mus., vol. 7, no. 1, Dec. 1915, p. 76, pl. 13, fig. 2, pl. xiv (Rio das Velhas).

One, 41 mm., Rio Jaguaribe, Russas, Ceará. Evidently a male with well developed lower caudal fulcrum.

##### *Cheirodon jaguaribensis* new species

Figure 91.

Depth  $2\frac{3}{4}$ ; head  $3\frac{1}{2}$ , width  $2\frac{1}{2}$ . Snout (in profile)  $4\frac{1}{2}$  in head; eye  $2\frac{1}{2}$ , greater than snout or interorbital; maxillary reaches  $\frac{1}{2}$  in (below) eye, length  $2\frac{1}{2}$  in head; mouth cleft very short, level with middle of eye, jaws subequal or nearly even; 8 rather large quidentate teeth in each jaw, apparently none on maxillaries; interorbital 3 in head, moderately elevated, convex; broad suborbitals entirely cover cheek. Gill opening wide, extends forward opposite middle of eye. Gill rakers 7+11, lanceolate,  $\frac{2}{3}$  of gill filaments, which are 2 in eye.

Scales 28+3 in axial lateral series; 8 scales in short decurved lateral line not reaching as far as end of depressed pectoral and 4 scales below to ventral origin; 11 scales transversely between dorsal and ventral origins; few basal scales along front of anal; caudal scaly over basal third of fin. Humeral

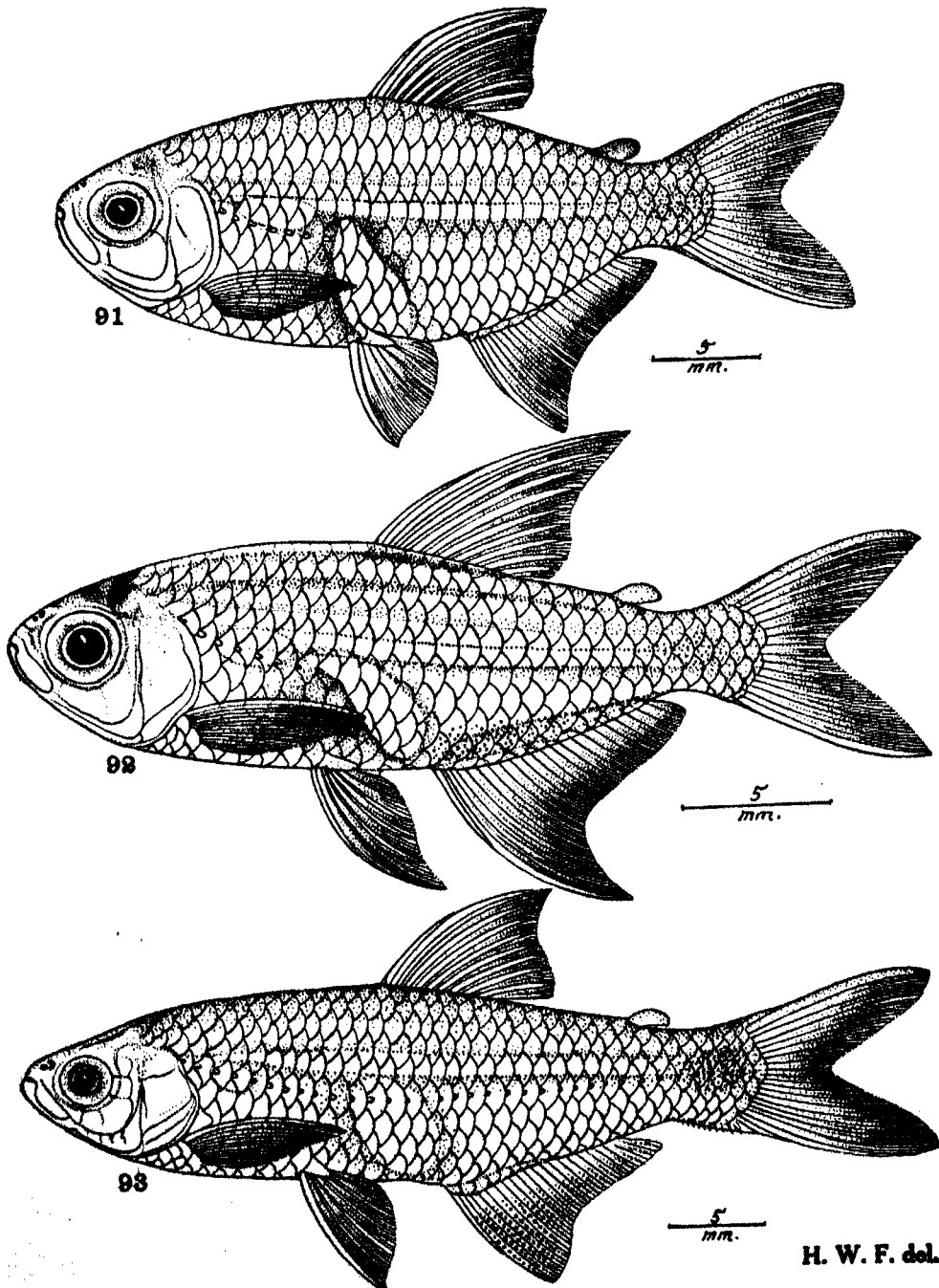


FIG. 91.—*Cheirodon jaguaribensis* new species. FIG. 92.—*Cheirodon macropterus* new species. FIG. 93.—*Odontostilbe theingi* new species.

extension short,  $\frac{1}{4}$  in fin length. Ventral with pointed axillary scale  $2\frac{1}{2}$  in fin. Pseudotympanum little elongate, little longer than eye.

D. III, 8, first branched ray  $3\frac{1}{2}$  in fish without caudal; adipose fin  $3\frac{1}{2}$  in head; A. III, 20, 1, first branched ray  $1\frac{1}{2}$ ; caudal 3 in rest of fish, rather well emarginated behind; least depth of caudal peduncle  $2\frac{1}{2}$  in head; pectoral  $1\frac{1}{2}$ , rays I, 10; ventral rays I, 6, fin  $1\frac{1}{2}$  in head.

Color in alcohol largely brown, paler and lighter below, apparently whitish when fresh. A moderately broad whitish band, less than eye in width, axial along side of body to caudal base, embracing dark gray line on tail and marked with obscured dark dots at caudal base. Fins all pale to whitish, uniform.

A.N.S.P. no. 69530. Rio Jaguaribe, Russas, Ceará. 1936. Length 38 mm. Type.

Differs from *Cheirodon piaba* chiefly in the absence of the dark caudal spot. There is only a very indistinct suffusion at the caudal base, made up of pale or dull brown dots, and not forming a definite spot as in *Cheirodon piaba*.

(Named for the Rio Jaguaribe.)

***Cheirodon macropterus* new species**

Figure 92.

Depth  $2\frac{1}{2}$  to 3; head  $3\frac{1}{2}$  to  $3\frac{3}{4}$ , width  $1\frac{1}{2}$  to  $2\frac{1}{2}$ . Snout (in profile) 4 to 5 in head; eye  $2\frac{1}{2}$  to  $2\frac{3}{4}$ , greater than snout or interorbital; maxillary reaches  $\frac{1}{2}$  to  $\frac{3}{4}$  in (below) eye, length  $2\frac{1}{2}$  to 3 in head; mouth cleft very short, level with middle of eye, jaws subequal to even in front; 10 rather large quin-dentate teeth in each jaw, apparently none on maxillaries; interorbital  $2\frac{1}{2}$  to  $2\frac{3}{4}$ , moderately high, convex; broad suborbital entirely covers cheek. Gill opening extends forward opposite first third in eye. Gill rakers 7+12, lanceolate, slender,  $\frac{2}{3}$  of gill filaments, which are 2 in eye.

Scales 26 to 29+3 or 4 in axial lateral series; 8 or 9 scales in short de-curved lateral line not reaching as far as end of depressed pectoral, and 4 scales below to ventral origin; 11 scales transversely between dorsal and ventral origins; anal base but narrowly scaly. Caudal scales over basal third of fin. Humeral extension  $\frac{1}{2}$  of depressed pectoral. Ventral with pointed axillary scale  $2\frac{1}{2}$  to  $3\frac{1}{2}$  in fin. Pseudotympanum elongated, little longer than eye.

D. III, 8, 1 or III, 9, first branched ray  $2\frac{3}{4}$  to  $3\frac{1}{2}$  in fish without caudal; adipose fin  $2\frac{3}{4}$  to  $3\frac{1}{2}$  in head; A. III, 19 to III, 23, first branched ray  $3\frac{1}{2}$  to  $4\frac{1}{2}$  in fish without caudal; caudal  $2\frac{3}{4}$  to  $3\frac{1}{2}$ , well emarginate behind; least depth of caudal peduncle  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in head; pectoral 1 to  $1\frac{1}{10}$ , rays I, 12; ventral rays I, 6, fin  $1\frac{1}{2}$  to  $1\frac{1}{10}$  in head.

Color in alcohol largely brown, paler and lighter below, evidently whitish in life. Lower sides of head and belly with shining whitish reflections, likely bright silvery white in life. On body whitish axial band, little less than eye in width, axial on side and including dark gray on tail, and with cluster of obscure dark dots on caudal base. Fins all pale to whitish.

A.N.S.P. no. 69531. Rio Jaguaribe, Russas, Ceará. 1936. Length 37 mm. Type.

A.N.S.P. nos. 69532 to 69538, same data, paratypes. Length 29 to 34 mm.

Differs from the known species of its genus in the very long dorsal, which when depressed reaches well into the adipose fin. Apparently closely related to *Cheirodon jaguaribensis*, evidently differing chiefly in its more slender body.

(*macropterus*, long-finned)

***Odontostile iheringi* new species**

Figure 93.

Depth  $3\frac{1}{2}$  to  $3\frac{3}{4}$ ; head  $3\frac{3}{4}$  to 4, width 2 to  $2\frac{1}{4}$ . Snout (in profile)  $4\frac{1}{4}$  to  $5\frac{1}{4}$  in head from snout tip; eye  $2\frac{3}{4}$  to  $3\frac{1}{4}$ , greatly exceeds snout or interorbital, subequal with interorbital with age; maxillary reaches  $\frac{1}{4}$  in eye, length  $2\frac{3}{4}$  to  $2\frac{1}{2}$  in head from snout tip; mouth cleft short, level with middle of eye and lower jaw produced; 10 tridentate teeth in upper jaw and 8 larger ones, quidentate, in front of mandible; maxillaries each with 2 small inner basal teeth; interorbital  $3\frac{1}{4}$  to  $3\frac{1}{2}$ , moderately high, convex; broad suborbitals broadly cover cheek, though postorbitals leave broad naked space behind and before preopercle. Gill opening wide, extends forward, opposite front eye edge. Gill rakers 7+12, lanceolate, slender,  $\frac{1}{4}$  of gill filaments which are  $1\frac{1}{4}$  in eye.

Scales 31 or 32+3 or 4 in lateral line; 6 above, 3 below to ventral origin, 4 below to anal origin, 13 predorsal forward to occipital extension. Caudal scaly over basal fifth. Anal with low band of basal scales anteriorly. Humeral extension  $\frac{1}{4}$  in depressed pectoral, obtuse. Ventral pointed, with axillary scale  $3\frac{1}{4}$  in fin. Lateral line complete, well decurved, ascends until median at caudal base, slender simple tubes well exposed. Pseudotympanum small, little less than eye. Anal rays medially and terminally each with row of small simple contact denticles.

D. III, 8, first branched ray  $3\frac{3}{4}$  to  $3\frac{1}{4}$  in fish without caudal; adipose fin  $3\frac{3}{4}$  to  $3\frac{1}{2}$  in total head length; A. III, 19, I or III, 20, I, first branched ray  $1\frac{1}{4}$  to  $1\frac{1}{2}$ ; least depth of caudal 2 to  $2\frac{1}{4}$ ; caudal  $2\frac{3}{4}$  to  $3\frac{1}{4}$  in rest of fish, well forked, lower fulcra well developed; pectoral 1 to  $1\frac{1}{4}$  in total head length, rays I, 11; ventral rays, I, 6, fin  $1\frac{3}{4}$  to  $1\frac{1}{2}$  in total head length.

Color in alcohol light brown, under surfaces paler to whitish. Sides of head and below silvery white. On body broad white axial band less than eye and reaches caudal base, and at latter a cluster of blackish dots. Iris silvery white. Fins all pale to whitish, dorsal terminally dusted with dark gray.

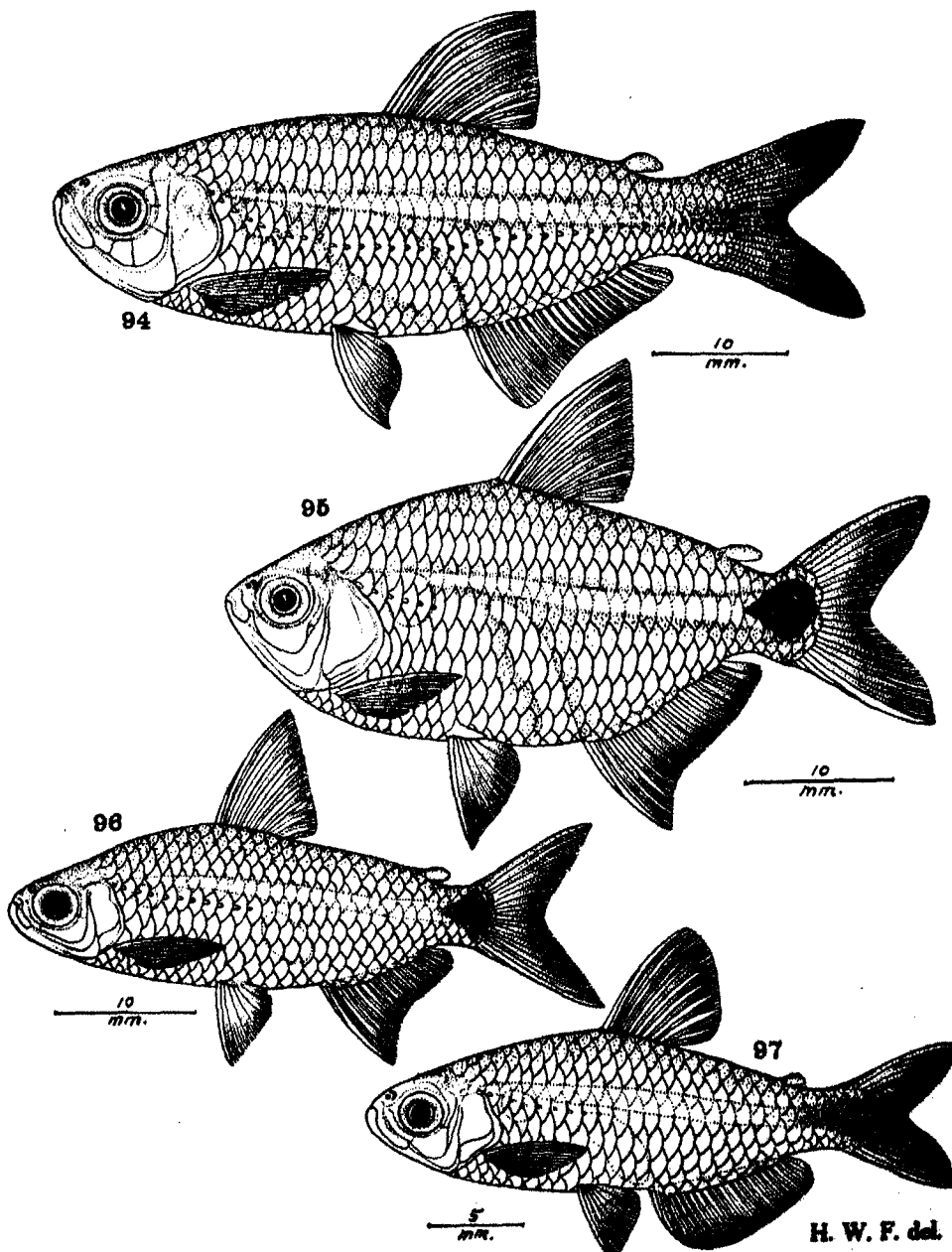
A.N.S.P. no. 69539. Rio Jaguaribe, Russas, Ceará. 1936. Length 48 mm. Type.

A.N.S.P. nos. 69540 to 69577, same data, paratypes. Length 26 to 45 mm.

Distinguished by its long maxillary, nearly as long as eye. In *Odontostilbe fugitiva* Cope the maxillary is only about  $\frac{1}{4}$  the eye; likewise *Odontostilbe paraguayensis* Eigenmann and Kennedy, but it is with greater body depth. The caudal spot though dark gray is subdued, diffuse and preceded by a silvery lateral axial band.

(In memory of the late elder Dr. Hermann von Ihering, the distinguished Brazilian naturalist.)



FIG. 94.—*Moenkhausia lepidura* (Kner).FIG. 95.—*Hyphessobrycon latus* new species.FIG. 96.—*Hyphessobrycon iheringi* new species.FIG. 97.—*Hyphessobrycon piabinhas* new species

## TETRAGONOPTERINAE

**Tetragonopterus argenteus** Cuvier "Patacas."

*Tetragonopterus argenteus* Cuvier, Règne Animal, vol. 2, 1817, p. 166 (on *Tetragonopterus* Seba, Thesaurus, 1758, pt. 3, p. 106, pl. 34, fig. 3, type locality, None given).—Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 263 (Contamana, Peru).

Five, 68 to 83 mm., Rio Parnahyba, Therezina, Piahy. 1936.

Nineteen, 41 to 103 mm., Rio Jaguaribe, Russas, Ceará. 1937.

Six, 63 to 105 mm., Rio Jaguaribe, Orós, Ceará. 1936.

**Moenkhausia lepidura** (Kner)

Figure 94 (Russas).

*Tetragonopterus lepidurus* Kner, Denks. Akad. Wiss. Wien, vol. 17, 1859, p. 176 (type locality, Rio Guapore).—Günther, Cat. Fish Brit. Mus., vol. 5, 1864, p. 328 (copied).

*Tetragonopterus lepidur* Kner, op. cit., pl. 8, fig. 20.

*Moenkhausia lepidura* Eigenmann, Mem. Mus. Comp. Zool., vol. 43, pt. 1, Aug. 1917, p. 98, pl. 8, fig. 2 (photograph) (Brazil; British Guiana).

Three, 64 to 72 mm., Rio Parnahyba, Therezina, Piahy. 1936. All show mandible a little prominent in front.

Twenty, 26 to 62 mm., Rio Jaguaribe, Russas, Ceará. All with the black terminal blotch on each caudal lobe tipped with white.

**Astyanax bimaculatus** (Linnaeus) "Piabas."

*Salmo bimaculatus* Linnaeus, Syst. Nat., ed. 10, pt. 1, 1758, p. 311 (type locality, "in America meridionali").

*Astyanax bimaculatus* Fowler, Proc. Acad. Nat. Sci. Phila., Dec. 8, 1915, p. 530 (Diego Martin R., Trinidad); vol. 78, 1926, p. 258 (Dolores, Bolivia); vol. 83, 1931, p. 393 (Trinidad); p. 408 (Guafico, Venezuela); vol. 91, 1939 (Feb. 20, 1940), p. 263 (Contamana, Peru).

*Poecilurichthys bimaculatus* Fowler, Proc. Acad. Nat. Sci. Phila., May 28, 1915, p. 263 (Rio Jaguaribe at Barra Alto).

One, 90 mm., Açude Lima Campos, Icó, Ceará. 1937.

One hundred eight, 18 to 81 mm., Rio Jaguaribe, Russas, Ceará. 1936.

Ten, 78 to 108 mm., Rio Jaguaribe, Orós, Ceará. 1936.

Thirty-eight, 21 to 85 mm., Forteleza, Ceará. 1937.

Seven, 18 to 33 mm., Rio Salgade, Icó, Ceará. 1937.

Fifteen, 28 to 69 mm., Rio Pacoty, Ceará. 1936.

Four, 60 to 64 mm., Rio Choró, Ceará. 1936.

Eleven, 44 to 98 mm., Lago Papary, Rio Grande do Norte. 1936.

Eleven, 54 to 88 mm., São José do Egito, Pernambuco. 1936.

One, 113 mm., Campina Grande, Parahyba. 1936. In this specimen the caudal has the rays greatly branched, the lower point much longer and the fin only very little emarginate behind; apparently the emargination is formed by the supero-median rays being the shortest.

**Hyphessobrycon latus** new species

Figure 95.

Depth  $2\frac{1}{2}$ ; head  $3\frac{1}{2}$ , width 2. Snout (in profile)  $4\frac{1}{2}$  in head; eye  $3\frac{1}{2}$ , greatly exceeds snout,  $1\frac{1}{2}$  in interorbital; maxillary short, small, reaches  $\frac{1}{2}$

to front of eye, length  $4\frac{1}{2}$  in head; mouth cleft very short, broad, closed jaws subequal or lower slightly included; teeth small, row of 10 in each jaw and 2 large, low, short teeth on each maxillary subbasally; interorbital 3, moderately elevated, convex; frontal fontanel begins in middle of interorbital width and reaches up into occipital extension; broad suborbitals cover cheek below or are in contact with preopercle ridge, and narrower postorbitals leave naked strip along vertical preopercle ridge. Gill opening wide, extends forward opposite front eye edge. Gill rakers 6+12, lanceolate, slender,  $\frac{1}{2}$  of gill filaments, which equal eye.

Scales 29+3 in lateral axial series; lateral line short, little decurved, only on 6 scales following from suprascapula, simple tubes small; 12 transversely between dorsal and anal origins. Caudal base with smaller scales than on body. Band of basal scales along each side of front part of anal. Humeral extension short, about  $\frac{1}{2}$  of depressed pectoral. Ventral with pointed axillary scale  $\frac{1}{2}$  length of fin. Pseudotympanum distinct, large as eye.

D. III, 9, first branched ray 1 in head; adipose fin  $1\frac{1}{2}$  in eye; A. III, 19, first branched ray  $1\frac{1}{2}$  in head; least depth of caudal peduncle  $2\frac{1}{10}$ ; caudal 3 in rest of fish, deeply emarginate, lobes equal; pectoral  $1\frac{1}{2}$  in head, rays I, 10; ventral rays I, 6, fin  $1\frac{1}{2}$  in head.

Color in alcohol pale or light brown generally, evidently whitish in life. Upper edge of back more brownish. Traces of narrow whitish axial band on side of tail, ending at caudal base in large black blotch little larger than eye. Iris whitish. Otherwise than mentioned for caudal fin, other fins pale or whitish.

A.N.S.P. no. 69578. Forteleza, Ceará. 1937. Length 50 mm. Type.

A species unique in its facies, coloration and structure combination. It would approach the species in Eigenmann's key with the "Dorsal plain" and with the "Caudal spot well developed, single." Its deeper body seems to distinguish it easily from all.

(*Latus* broad.)

#### ***Hypheosobrycon iheringi* new species**

Figure 96.

Depth  $2\frac{3}{4}$ ; head  $3\frac{1}{2}$ , width  $2\frac{1}{10}$ . Snout (in profile)  $5\frac{1}{2}$  in head from snout tip; eye  $2\frac{1}{2}$ , greatly exceeds snout, subequal with interorbital; maxillary small, reaches opposite front of eye, length  $3\frac{1}{2}$  in head from snout tip; mouth cleft very short, closed lower jaw protruding a little in front; 10 quidentate teeth in each jaw, and 2 short low teeth on each maxillary subbasally; interorbital  $2\frac{1}{2}$  in head from snout tip; suborbitals broad, completely cover cheek to preopercle ridge; opercle smooth. Gill opening extends forward opposite front pupil edge. Gill rakers 7+10, lanceolate, slender, length  $\frac{1}{2}$  of gill filaments, which are  $\frac{3}{4}$  of eye.

Scales 26+3 in axial lateral series with lateral line extending over 11 scales following from suprascapula, small tubes all simple; 12 transversely between dorsal and anal origins; 10 predorsal extending forward to hind end of supraoccipital extension. Caudal base with small scales. Front of anal base with short band of basal scales. Humeral extension short,  $\frac{1}{2}$  of depressed pectoral. Ventral without distinct free pointed axillary scale. Pseudotympanum small,  $\frac{1}{2}$  of eye.

D. III, 9, first branched ray  $3\frac{3}{4}$  in fish without caudal; adipose fin  $3\frac{1}{2}$  in total head length; A. III, 18, first branched ray  $1\frac{1}{10}$ ; least depth of caudal peduncle  $2\frac{1}{10}$ ; caudal  $2\frac{3}{4}$  in rest of fish, deeply emarginate, lobes equal; pectoral 1 in total head length, rays I, 10; ventral rays I, 6, fin  $1\frac{3}{4}$  in total head length.

Color in alcohol very light brown, evidently whitish in life. Edge of back dark brown. Traces of narrow axial lateral band, wide as pupil and ending at caudal base in large black blotch size of eye. Iris whitish. Fins all uniformly pale.

A.N.S.P. no. 69579. Forteleza, Ceará. 1937. Length 42 mm. Type.

Only the type specimen secured. It is related to *Hyphessobrycon latus* but differs at once in its more slender body and broad suborbitals, though the structure of its fin rays and scalation is similar.

(For the late Dr. Rudolpho von Ihering.)

*Hyphessobrycon piabinhas* new species "Piabinhas."

Figure 97.

Depth 3 to  $3\frac{3}{4}$ ; head  $3\frac{3}{4}$  to  $3\frac{3}{4}$ , width 2. Snout (in profile)  $4\frac{1}{2}$  to 5 in head from snout tip; eye  $2\frac{3}{4}$  to  $2\frac{1}{2}$ , greatly exceeds snout, greater than interorbital; maxillary reaches  $\frac{1}{4}$  to  $\frac{1}{8}$  in eye, length  $2\frac{1}{4}$  to  $2\frac{3}{4}$  in head from snout tip; mouth with very short cleft, slightly above level from middle in vertical diameter of eye, lower jaw well protruded in front; teeth 8 in front of each jaw, with mandibular little larger and apparently quincuspid, at least latter; maxillary teeth not made out; interorbital low, broadly convex, width  $2\frac{1}{4}$  to 3 in head from snout tip; broad suborbitals smooth, entirely cover cheek. Gill openings wide, extend forward nearly opposite front edge of eye. Gill rakers 7+11, lanceolate, slender,  $1\frac{1}{2}$  in gill filaments, which are  $1\frac{3}{4}$  in eye.

Scales 26 to 28+3 or 4 in axial lateral series, of which only first 5 to 9 tubular and form lateral line; 11 transversely between dorsal and anal origins; 9 predorsal forward to hind end of supraoccipital extension. Caudal base moderately scaly. None of fins with basal scaly sheaths. Humeral extension  $\frac{1}{2}$  length of depressed pectoral. Small pseudotympanum much less than eye in extent.

D. II, 8, 1, first branched ray 1 to  $1\frac{1}{10}$  in total head length; adipose fin  $4\frac{1}{4}$  to  $4\frac{3}{4}$ ; A. III, 19, 1, first branched ray  $1\frac{1}{2}$  to  $2\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{4}$  to  $2\frac{3}{4}$ ; caudal  $3\frac{1}{4}$  to  $4\frac{3}{4}$  in rest of fish, deeply emarginate; pectoral  $1\frac{1}{2}$  to  $1\frac{1}{4}$  in total head length, rays I, 10; ventral rays I, 6, fin length  $1\frac{1}{2}$  to  $1\frac{1}{4}$  in total head length.

Color in alcohol brownish, without any conspicuous markings, scarcely paler on under surfaces of body. Iris grayish. Traces of a pale or silvery white axial lateral band, much narrower than eye diameter in width, from shoulder to middle of caudal base, where most of area becomes dusted with dark brown. No dark suprascapular blotch or cluster of dark dots. Fins all darker than general body color. All small examples have body generally paler in color, but with dark basal caudal spot well contrasted.

A.N.S.P. no. 69580. Forteleza, Ceará. 1937. Length 32 mm. Type.

A.N.S.P. nos. 69581 to 69593, same data, paratypes. Length 30 to 40 mm.

A.N.S.P. nos. 69594 to 69600. Rio Salgade, Icó, Ceará. 1937. Length 20 to 29 mm. Paratypes.

Known by its elongate body and combination of structural characters and coloration, especially in the absence of a dark humeral spot and the presence of a dark brown diffusion at the caudal base.

(*Piabinhas* the Brazilian name.)

***Psellogrammus kennedyi* (Eigenmann)**

*Hemigrammus kennedyi* Eigenmann, Proc. Acad. Nat. Sci. Phila., 1903, p. 520 (type locality, Campo Grande, Paraguay; Arroyo Trementina).

*Psellogrammus kennedyi* Eigenmann, Mem. Mus. Comp. Zool., vol. 43, pt. 4, May 1927, p. 336, pl. 32, fig. 1 (Brazil; Paraguay).—Fowler, Proc. Acad. Nat. Sci. Phila., vol. 84, Aug. 18, 1932, p. 357 (Descalvados).

One, 51 mm., Forteleza, Ceará. 1937. Depth  $2\frac{3}{4}$ . Scales  $30+3$ . A. III, 36.

***Bryconamericus megalepis* new species**

Figure 98.

Depth 3 to  $3\frac{1}{4}$ ; head  $3\frac{3}{4}$  to  $3\frac{1}{2}$ , width  $1\frac{1}{4}$  to 2. Snout (in profile)  $4\frac{1}{2}$  to  $4\frac{3}{4}$  in head from snout tip; eye  $2\frac{3}{4}$  to 3, greater than snout or interorbital, eyelids free all around; maxillary moderate, reaches little below front of eye in young to  $\frac{1}{2}$  in eye with age, length  $2\frac{3}{4}$  to 3 in head from snout tip; mouth cleft very short, wide, little above level of eye center to nearly level with upper edge of pupil, and closed mandible protruded in front; teeth 10 in each jaw, quincuspid, lower larger and 2 very minute low broad subbasal teeth on each maxillary; interorbital  $2\frac{1}{4}$  to  $3\frac{1}{2}$  in head from snout tip, moderately high, convex; broad suborbitals cover cheek below to preopercle ridge, with rather naked strip behind or before vertical preopercle ridge; bones of head smooth. Gill opening extends forward opposite front pupil edge. Gill rakers  $7+14$ , lanceolate, slender,  $\frac{1}{2}$  of gill filaments or  $1\frac{1}{2}$  in eye.

Scales 27 or  $28+3$  or 4 in lateral line; 6 above to dorsal origin, 4 below to ventral origin, 5 below to anal origin, 12 or 13 predorsal forward to hind end of supraoccipital extension. Caudal base scaly. Anal with basal band of scales, better developed anteriorly. Humeral extension short, blunt, about  $\frac{1}{2}$  of depressed pectoral. Ventral without free pointed axillary scale. Pseudotympanum small, distinct, much less than eye.

D. II, 8, 1, first branched ray 1 in total head length; adipose fin 3 to 4; A. III, 20, 1, first branched ray  $1\frac{1}{4}$  to  $1\frac{1}{2}$ ; least depth of caudal peduncle 2 to  $2\frac{3}{4}$ ; caudal  $2\frac{3}{4}$  to 3 in rest of fish, deeply forked lobes equal; pectoral  $1\frac{1}{4}$  to  $1\frac{1}{2}$  in total head length, rays I, 10; ventral rays I, 7, fin  $1\frac{1}{4}$  to  $1\frac{1}{2}$  in total head length.

Color in alcohol pale or very light brown, evidently whitish in life. Back and upper surfaces brownish above or along edge of back. Iris whitish. Narrow silvery axial lateral band, ending in large blackish blotch on caudal base medially. Otherwise fins all largely uniformly pale.

A.N.S.P. no. 69602. Forteleza, Ceará. Length 43 mm. Type.

A.N.S.P. nos. 69603 to 69605, same data, paratypes. Length 34 to 45 mm.

Differs from *Bryconamericus microcephalus* (Ribeiro) 1908, and *Bryconamericus stramineus* Eigenmann 1908 in coloration and larger scales, the latter character also distinguishing it from the other known species.

(μέγας large + λεπὴς scale.)

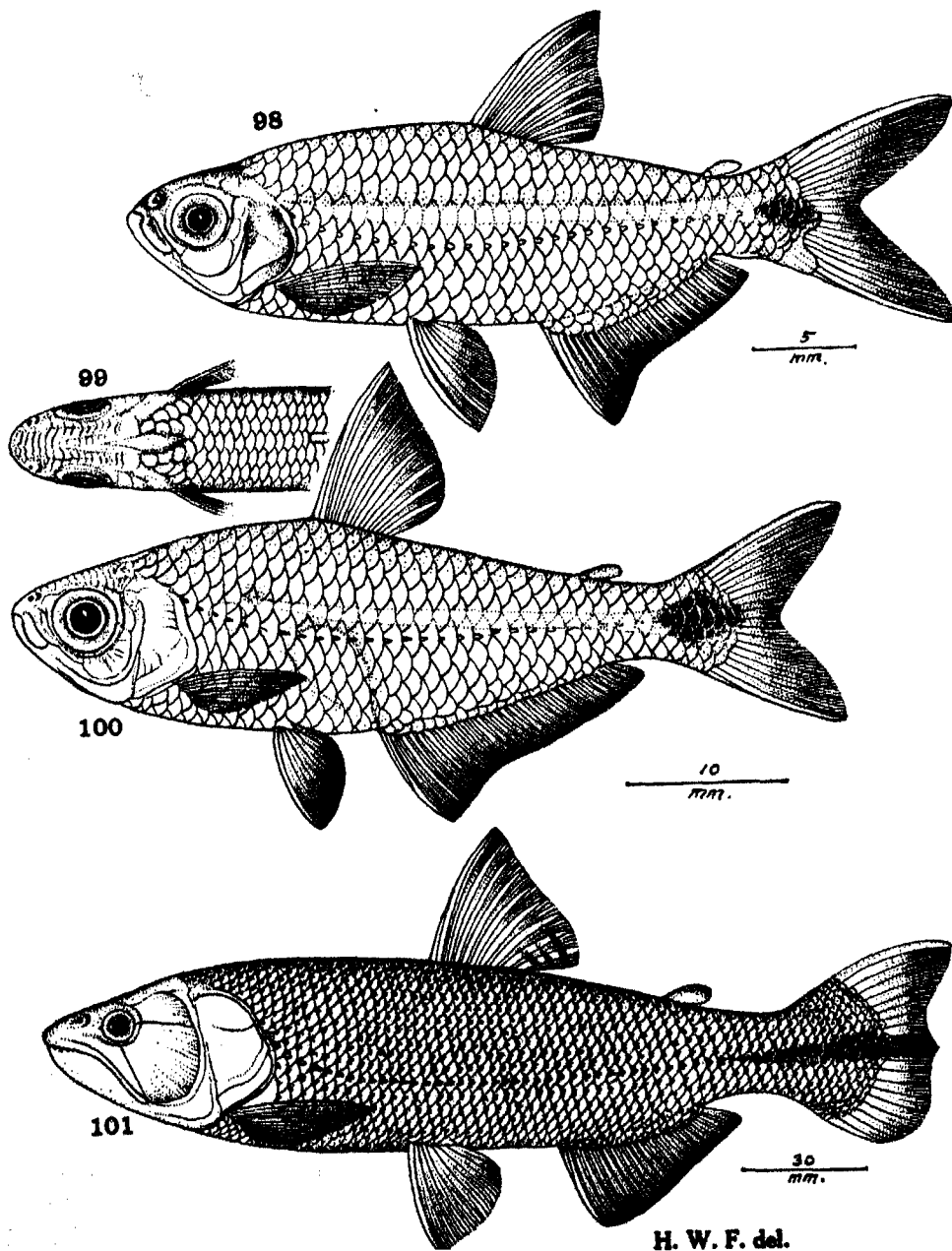


FIG. 98.—*Bryconamericus megalepis* new species.

FIGS. 99 and 100.—*Grammabrycon calverti* new species.

FIG. 101.—*Brycon erythrura* new species.

**GRAMMABRYCON** new genus

**TYPE.**—*Grammabrycon calverti* new species.

Body elongately ovoid in contour, well compressed, moderately deep, tail greatly longer than trunk. Head moderate, compressed, obtuse. Snout short, obtuse. Eye large, well advanced in head. Maxillary rather long, extends below front of eye. Mouth small, closed lower jaw slightly inferior or shorter than upper. Teeth small, biserial above, uniserial below, tricuspid. All along lower edge of maxillary row of small denticles, rather numerous. Interorbital somewhat broadly convex. Frontal fontanel well developed, begins in middle of interorbital and reaches into supraoccipital extension. Nostrils together, on upper front side of snout. On upper front region of head inclusive of interorbital, numerous transverse parallel striae or lines crossing completely over. Broad suborbitals largely cover cheek, though leave narrow strip of naked skin all along edge of preopercle ridge. Gill opening large. Gill rakers large, slender. Scales moderate, cycloid, smooth, compact and adherent. Caudal and anal bases scaly. Humeral extension short. Very small scale in ventral axil. Pseudotympanum small. Air bladder large, transparent. Lateral line complete, moderately decurved. Dorsal insertion premedian, fin pointed. Adipose fin small, over last anal rays. Anal long, base  $3\frac{1}{2}$  times total length of fish and front rays little highest. Caudal broad, emarginate. Pectoral small, low. Ventral inserted before dorsal, moderate. Coloration largely whitish.

A genus suggestive of *Phenacogaster* Eigenmann, differing in the presence of transverse striae or lines across the upper front of the head.

(γρᾰμμᾰ line + *Brycon*.)

**Grammabrycon calverti** new species

Figures 99 (head above) and 100.

Depth 3; head  $3\frac{1}{2}$ , width 2. Snout (in profile)  $4\frac{1}{2}$  in head from snout tip; eye 3, greatly exceeds snout or interorbital; maxillary moderate, reaches opposite front eye edge, length  $3\frac{1}{2}$  in head; mouth cleft very short, level with middle of eye and closed mandible slightly included in upper jaw; teeth biserial above, 12 in outer series, tricuspid and similar single row in mandible; maxillary edge with 15 or 16 very small short nearly uniform denticles; interorbital  $3\frac{1}{2}$  in head, convex; broad suborbitals nowhere touching preopercle, though largely covering cheek and postorbital, all more or less striate, likewise opercle marginally behind. Upper part of snout and interorbital with many transverse lines or striae. Gill opening extends forward opposite middle of eye. Gill rakers 7+8, 1, length  $\frac{1}{2}$  of gill filaments, which are  $1\frac{1}{2}$  in eye.

Scales 30+3 in lateral line; 7 above, 5 below to ventral origin, 5 below to anal origin; 12 predorsal forward to hind end of supraoccipital extension. Caudal with basal fourth scaly. Band of small basal anal scales. Humeral extension blunt, length  $\frac{1}{2}$  in depressed pectoral. Ventral with very small, short axillary scale. Lateral line decurved, reaches middle of caudal base and end of caudal scalation, simple slender tubes all well exposed. Pseudotympanum much smaller than eye.

D. III, 8, first branched ray  $1\frac{1}{10}$  in total head length; adipose fin 5; A. III, 29, first branched ray  $1\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{2}$ ; caudal  $3\frac{1}{2}$

in rest of fish, well emarginate behind; pectoral  $1\frac{1}{2}$  in total head length, rays I, 11; ventral rays I, 6, fin  $1\frac{1}{2}$  in total head length.

Color in alcohol very pale yellowish brown, apparently whitish in life. Upper surface of head brownish, though back not darker than lower surfaces. Narrow dark band along side of body axially, evidently silvery white in life and anteriorly or behind pseudotympanum cluster of dark or blackish dots, smaller than eye in extent. Larger compact area of dark dots at caudal base medially. Iris whitish. Fins all pale to whitish, dorsal and anal little darker terminally.

A.N.S.P. no. 69606. Forteleza, Ceará. 1937. Length 50 mm. Type.

Characters largely included in the above generic account.

(For Dr. Philip P. Calvert, well known for his contributions on the Odonata.)

#### BRYCONINAE

*Brycon erythrura* new species "Jutubaranas."

Figure 101.

Dorsal  $2\frac{3}{4}$  to 4; head  $3\frac{1}{4}$  to  $3\frac{3}{4}$ , width  $2\frac{1}{6}$  to  $2\frac{1}{4}$ . Snout (in profile) 4 to  $4\frac{1}{2}$  in head; eye  $4\frac{1}{2}$  to  $6\frac{1}{2}$ ,  $1\frac{1}{4}$  to  $1\frac{1}{2}$  in snout,  $1\frac{1}{2}$  to 2 in interorbital; maxillary long, sheathed by suborbital above, reaches to hind eye edge or  $\frac{1}{2}$  eye diameter beyond and length from snout tip  $1\frac{9}{10}$  to 2 in head, little more arched or bent with age; mouth large, cleft level with or little below level of lower eye edge, closed mandible included in upper jaw or jaws even in front; teeth small, compressed, pointed, biserial in upper jaws, and extend along whole lower edge of maxillary; upper front lateral teeth little larger than others in upper series, and inner anterior series close behind outer, smaller and fewer; teeth in mandible with 4 front ones enlarged, but not followed by inner symphyseal pair; interorbital  $3\frac{1}{2}$  to  $3\frac{3}{4}$  in head, broadly convex; broad suborbitals largely cover cheek and postocular, leave only narrow strip of skin concavely formed by arch of preopercle ridge. Gill opening extends forward opposite hind eye edge. Gill rakers 6+8 developed, lanceolate, equal gill filaments or  $1\frac{1}{2}$  in eye.

Scales 49 to 53+5 or 6 in lateral line; 10 or 11 above, 6 below to ventral origin, 7 below to anal origin; 22 predorsal forward to hind end of supraoccipital extension. Caudal base scaly. Anal with rather broad scaly basal band. Humeral extension obtuse, extends  $\frac{1}{2}$  in depressed pectoral. Ventral with pointed axillary scale  $2\frac{1}{2}$  in fin. Lateral line complete, well decurved, extends low on body and reaches up to caudal base medially and out over its scalation; small tubes rather pointed and inconspicuous.

D. III, 9, 1, first branched ray  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in head; adipose fin 5 to  $5\frac{1}{2}$ ; A. III, 21, 1 to III, 23, 1, first branched ray  $2\frac{1}{2}$  to  $2\frac{3}{4}$ ; caudal  $1\frac{1}{2}$  to  $1\frac{3}{4}$ , ends in 3 points behind; least depth of caudal peduncle 3 to  $3\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$  to  $1\frac{3}{4}$ , rays I, 10; ventral rays I, 7, fin  $1\frac{1}{2}$  to 2 in head.

Color in alcohol brown, more or less sienna, lower half of body and under surfaces whitish. Sides of head below bright shining silvery white. Iris whitish. Mandible and lips pale. Each scale on back and sides with dark gray to blackish spot, forming longitudinal rows in scale courses though all becoming paler below lateral line. Dorsal brownish, pale to olive-buff basally and sometimes last few rays may be crossed by several gray bars. Caudal bright basally and with black median horizontal band,



including median point behind, outer or marginal part of fin yellow, red when fresh. Adipose fin light brown. Lower fins all pale or whitish. Anal sometimes pink on front lobe and terminal part of short rays may be dark gray.

A.N.S.P. no. 69608. Rio Jaguaribe, Orós, Ceará. 1937. Length 226 mm. Type.

A.N.S.P. nos. 69609 to 69613, same data, paratypes. Length 103 to 113 mm.

A.N.S.P. nos. 69614 to 69618. Rio Jaguaribe, Russas, Ceará. Length 103 to 163 mm. Paratypes.

Apparently like *Brycon orbignyanus* (Valenciennes) of the La Plata and the adult described as *Brycon orthotaenia* by Günther. It differs in coloration and in that "a straight, broad, deep-black band runs along the middle of the free portion of the tail and along the middle caudal rays." The caudal is described as only slightly emarginate.

( $\epsilon\upsilon\upsilon\phi\rho\acute{o}s$  red +  $\omicron\iota\pi\grave{a}$  tail.)

**Brycon matrinchao** new species "Matrinchão."

Figure 102.

Depth  $2\frac{3}{4}$ ; head  $3\frac{3}{4}$ , width  $1\frac{1}{2}$ . Snout (in profile)  $4\frac{1}{2}$  in head; eye  $3\frac{3}{4}$ , greatly exceeds snout,  $1\frac{1}{2}$  in interorbital, rather wide adipose lids cover  $\frac{1}{2}$  of iris; maxillary reaches  $\frac{3}{4}$  in eye, narrowly sheathed above by suborbital, length  $2\frac{3}{4}$  in head; mouth cleft extends  $\frac{3}{4}$  to eye, horizontal, level with middle of eye and closed jaws even in front; upper jaw with 22 short conic teeth in outer series, followed by 2 series of tridentate teeth with 4 or 5 posterior median ones greatly broadened and enlarged, also tridentate; maxillary with row of short teeth all along its lower edge; each side of lower jaw 4 enlarged quidentate teeth, and with an inner symphyseal close-set pair of small conic teeth; interorbital  $2\frac{1}{4}$  in head, well elevated, broadly convex; broad suborbitals largely cover cheek, leave only narrow naked strip along preopercle ridge. Gill opening extends forward opposite middle of eye. Gill rakers 12+17, lanceolate,  $\frac{1}{2}$  gill filaments, which are  $1\frac{1}{2}$  in eye.

Scales 48+6 in lateral line; 13 above, 7 below to ventral origin, 8 below to anal origin; 22 predorsal forward to hind end of supraoccipital extension. Broad scaly band basally on caudal and broad one on anal covers basal half of fin. Obtuse humeral extension  $\frac{1}{2}$  of depressed pectoral. Ventral with pointed axillary scale  $2\frac{3}{4}$  in fin. Lateral line complete, decurved, reaches middle of caudal base and hind end of caudal scalation.

D. III, 8, 1, first branched ray  $1\frac{1}{2}$  in head; adipose fin 4; A. III, 25, 1, third branched ray  $2\frac{1}{4}$ ; caudal 1, ends in 3 points behind; least depth of caudal peduncle  $2\frac{1}{4}$ ; pectoral  $1\frac{1}{2}$ , rays I, 13; ventral rays I, 6, fin  $1\frac{1}{2}$  in head.

Color in alcohol brown above, paler below. Each row of scales on body with median dark line or narrow band longitudinally. Black rounded blotch, smaller than eye, behind suprascapula and above lateral line. A much larger black blotch on caudal base. Caudal with dark or brown saddle above and below, not terminal. Fins otherwise all brownish.

A.N.S.P. no. 69619. Rio Parnahyba, Therezina, Piahy. 1936. Length 186 mm. Type.

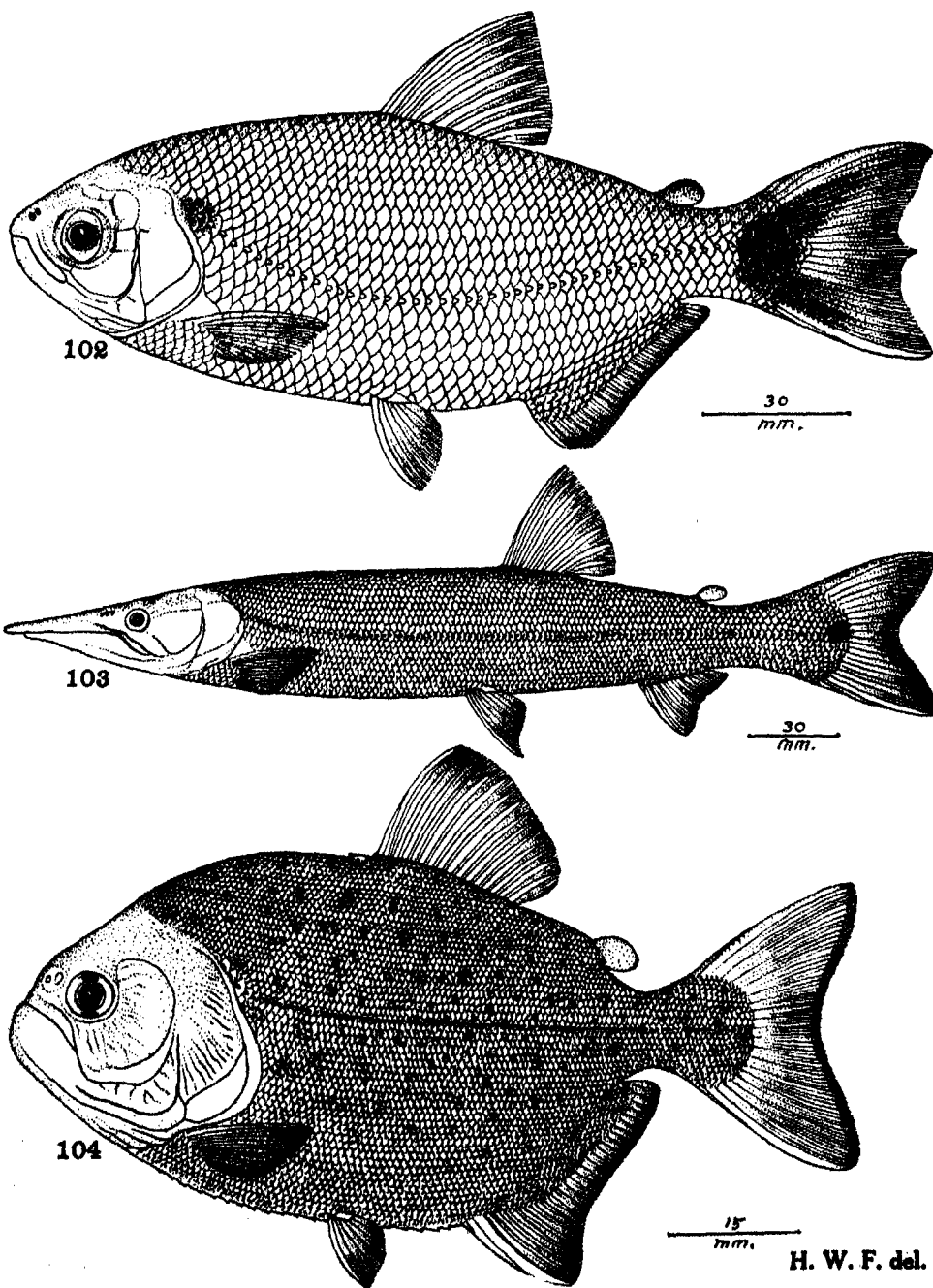


FIG. 102.—*Brycon matrinchao* new species. FIG. 103.—*Hydrocynus cuvieri* (Agassiz).  
FIG. 104.—*Serrasalmus striolatus* Steindachner.

Only the type obtained. Differs from the known species in the combination of its structural characters and coloration. In its small scales it approaches *Brycon hilarii* (Valenciennes), but entirely different from my Descalvos specimens.<sup>23</sup>

(*Matrinchão* the Brazilian name.)

#### GASTERPELECINAE

##### *Triportheus angulatus* (Agassiz) "Sardinha."

*Chalceus angulatus* Agassiz, Select. Gener. Spec. Pisc. Brasil, 1829, p. 67, pl. 34 (type locality, "in Brasiliae aequinoctialis fluviis").

*Chalcinus angulatus* Garman, Bull. Essex Inst., vol. 22, 1890 (1891), p. 3 (Brazilian localities).—Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 265 (Boca Chica, Peru).

One, 125 mm., Rio Jaguaribe, Orós, Ceará. 1936.

Two, 112 to 147 mm., same data. 1937.

One, 119 mm., Rio Jaguaribe, Russas, Ceará. 1937.

One, 108 mm., Rio Jaguaribe, Ceará. 1936.

Two, 115 to 135 mm., Rio Parnahyba, Therezina, Piauh. 1936.

One, 133 mm., Piancó, Parahyba. 1936.

Three, 103 to 112 mm., Lago Papary, Rio Grande do Norte. 1936.

##### *Roeboides microlepis* (Reinhardt)

*Epicyrtus microlepis* Reinhardt, Vidensk. Meddel. Naturh. Foren. Kjöbenhavn, 1849, nr. 1-2, p. 46 (type locality, Brazil; on Valenciennes).—Kner, Sitzsb. Akad. Wiss. Wien, vol. 32, 1858, p. 167; Denks. Akad. Wiss. Wien, vol. 18, 1860, p. 47, pl. 6, fig. 13 (Brazil).

*Anacyrtus microlepis* Günther, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 347 (copied).

*Epicyrtus gibbosus* (not Linnaeus) Valenciennes, Hist. Nat. Poiss., vol. 22, 1849, p. (33) 43, pl. 636 (Brazil; Surinam).

Five, 137 to 220? mm., Rio Jaguaribe, Ceará.

##### *Hydrocynus cuvieri* (Agassiz) "Facão."

Figure 103.

*Xiphostoma cuvieri* (Spix) Agassiz, Sel. Gener. Spec. Pisc. Brasil., 1829, p. 79, pl. 42 (type locality, "in Brasiliae fluviis").—Günther, Cat. Fish. Brit. Mus., vol. 5, 1864, p. 357 (copied).

One, 223 mm.?, Rio Parnahyba, Therezina, Piauh. 1936.

#### SERRASALMINAE

##### *Serrasalmus nattereri* Kner "Charuto", "Piranha."

*Pygocentrus nattereri* Kner, Sitzsb. Akad. Wiss. Wien, vol. 32, 1858, p. 166 (type locality, Brazil).

*Serrasalmo nattereri* Kner, Denks. Akad. Wiss. Wien, vol. 18, 1860, p. 36, pl. 3, fig. 8.

*Serrasalmus nattereri* Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 271 (Contamana, Peru).

Three, 162 to 294 mm., Ceará. 1937.

Three, 160 to 170 mm., Lago Papary, Rio Grande do Norte. 1936.

<sup>23</sup> Proc. Acad. Nat. Sci. Phila., vol. 84, Aug. 18, 1932, p. 357, fig. (lower one on p. 346).

One, 217 mm., Therezina, Piauhy. 1936.

One, 140 mm., Rio Parnahyba, Therezina, Piauhy. 1936.

**Serrasalmus striolatus** Steindachner "Piranha." Figure 104.

*Serrasalmus (Pygocentrus) striolatus* Steindachner, Anzeiger Akad. Wiss. Wien, vol. 45, nr. 18, 1908, p. 360 (type locality, "zuflüssen des Rio Pará").

*Serrasalmus striolatus* Norman, Proc. Zool. Soc. London, Jan. 21, 1929, p. 794, text fig. 10 (outline) (British Guiana; Brazil).

Eight, 32 to 94 mm., Rio Jaguaribe, Russas, Ceará. 1936.

**Serrasalmus rhombeus** (Linnaeus)

*Salmo rhombeus* Linnaeus, Syst. Nat., ed. 12, pt. 1, 1766, p. 514 (type locality, Surinam).

*Serrasalmus rhombeus* Fowler, Proc. Acad. Nat. Sci. Phila., April 1915, p. 265 (Barro Alto, Brazil); vol. 91, 1939 (Feb. 20, 1940), p. 271 (Contamana, Peru).

Two, 94 to 163 mm., Forteleza, Ceará. 1937. Both with dark humeral blotch and larger with blackish suffusion at caudal base. Back and upper sides with small irregular dark gray spots.

Three, 91 to 120 mm., Rio Parnahyba, Therezina, Piauhy. 1936.

One, 162 mm., Lago Papary, Rio Grande do Norte. 1936.

**Mylopius asterias** (Müller and Troschel) "Piranha."

*Myletes asterias* Müller and Troschel, Horae Ichth., pt. 1, 1845, pp. 24, 36, pl. 10, fig. 2 (teeth) (type locality, Guiana).

*Mylopius asterias* Eigenmann, Mem. Carnegie Mus., vol. 5, June 1912, p. 392, pl. 57, fig. 3 (Malali, British Guiana).—Norman, Proc. Zool. Soc. London, 1928 (Jan. 31, 1929), p. 824, (types; types of *Myletes ellipticus* Günther).

One, 185 mm., Therezina, Piauhy. 1936.

## ERYTHRINIDAE

**Hoplias malabaricus** (Bloch) "Trahira."

*Esox malabaricus* Bloch, Naturg. Ausland. Fische, vol. 8, 1794, p. 149, pl. 392 (type locality, "Tranquebar" = tropical South America).

*Hoplias malabaricus* Fowler, Proc. Acad. Nat. Sci. Phila., Sept. 22, 1906, p. 293 (Amby-iacu R.; Rio Grande do Sul; Bahia; Rio das Velhas; Surinam).—Eigenmann, Mem. Carnegie Mus., vol. 5, June 1912, p. 414, pl. 62, fig. 2 (British Guiana).—Fowler, op. cit., vol. 91, 1939 (Feb. 20, 1940), p. 275 (Contamana, Peru).

Four, 57 to 98 mm., Campina Grande, Parahyba. 1936.

One, 155 mm., São José do Egito, Pernambuco. 1936.

One, 198 mm., Lago Papary, Rio Grande do Norte. 1936.

**Hoplerythrinus unitaeniatus** (Agassiz)

*Erythrinus unitaeniatus* (Spix) Agassiz, Select. Gener. Spec. Pisc. Brasil., 1829, p. 42 (type locality, "in flumine S. Francisci").

*Hoplerythrinus unitaeniatus* Eigenmann, Mem. Carnegie Mus., vol. 5, June 1912, p. 418 (British Guiana).—Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 275 (Contamana, Peru).

*Erythrinus 1-taeniatus* (Spix) Agassiz, op. cit., pl. 19.

Two, 157 to 222 mm., Rio Cocó, Forteleza, Ceará. 1936. Scales 30+3.

## GYMNOTIDAE

**Eigenmannia virescens** (Valenciennes) "Pestana", "Charuto."

*Sternachus virescens* Valenciennes, Voy. l'Amerique Merid., Orbigny, vol. 5, pt. 2, Poiss., 1847, p. 11, pl. 13, fig. 2 (type locality, None given) (error).

*Eigenmannia virescens* R. von Ihering, Revista Mus. Paulista, vol. 7, 1907, p. 283, pl. 8, fig. 3 (Brazil).—Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 276 (Contamana, Peru).

One, 287 mm., Rio Parnahyba, Therezina, Piahy. 1936.

Four, 120 to 180 mm., Rio São Francisco, Jatobá, Pernambuco. 1936.

**Sternopygus macrurus** (Schneider) "Sarapo."

*Gymnotus macrurus* Schneider, Syst. Ichth. Bloch, 1801, p. 522 (type locality, Brazil).

*Sternopygus macrurus* Müller and Troschel, Horae Ichth., pt. 3, 1849, p. 14.—Ellis, Mem. Carnegie Mus., vol. 6, no. 3, 1913, p. 121, fig. 3 (outline of head) (British Guiana; Brazil).

One, 245 mm., São José do Egito, Pernambuco. 1936.

One, 308 mm., Rio São Francisco, Jatobá, Pernambuco. 1936.

One, 355 mm., Rio Parnahyba, Therezina, Piahy. 1936.

**Sternarchella schotti** (Steindachner) "Sarapo."

*Sternarchella schotti* Steindachner, Sitzsb. Akad. Wiss. Wien, vol. 58, 1868, p. 252, pl. 1, figs. 1-2 (head and tail) (type locality, Barra do Rio Negro).

*Sternarchella schotti* Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 277 (Contamana, Peru).

One, 353 mm., Rio São Francisco, Jatobá, Pernambuco. 1936.

**Rhamphichthys rostratus** (Linnaeus)

*Gymnotus rostratus* Linnaeus, Syst. Nat., ed. 12, pt. 1, 1758, p. 428 (type locality, America).

*Rhamphichthys rostratus* R. von Ihering, Revista Mus. Paulista, vol. 7, 1907, p. 297 (Brazil).—Ellis, Mem. Carnegie Mus., vol. 6, no. 3, Sept. 1913, p. 137, fig. 8 (outline head) (Guiana; Bolivia; Brazil).—Fowler, Copeia, no. 15, Feb. 20, 1915 (Peruvian Amazon); Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 288 (reference).

One, 635 mm., Rio Parnahyba, Therezina, Piahy. 1936. Ellis gives the distribution as "South America, except the Magdalena and Brazilian coastal streams."

## POECILIIDAE

**Poecilia vivipara** Schneider "Guarús", "Guarú."

*Poecilia vivipara* Schneider, Syst. Ichth. Bloch, 1801, p. 452, pl. 86, fig. 2 (type locality, Surinam).—Eigenmann, Mem. Carnegie Mus., vol. 5, June 1912, p. 456, pl. 64, figs. 3-4 (photograph) (Georgetown, British Guiana).—Regan, Proc. Zool. Soc. London, Dec. 1913, p. 1005, text-fig. 173C (gonopodium) (Venezuela; Leeward Islands; La Plata).—Fowler, Proc. Acad. Nat. Sci. Phila., Aug. 30, 1916, p. 438 (Surinam; Hucare and Guanica, Porto Rico); Sept. 9, 1919, p. 130 (Surinam).

Female, 44 mm., Rio Jaguaribe, Russas, Ceará. 1937. Without black markings.

Two males 35 to 45 mm., twelve females 22 to 37 mm., Rio Choró, Ceará. 1936.

Six males 26 to 31 mm., eight females 45 to 48 mm., Rio Pacoty, Ceará. Females with variable black blotch at base of caudal above, sometimes reduced to only a narrow black margin on fin. In male usually a black lateral blotch below and before dorsal. Some males with black margin to fin base above and below, or upper may be more blotch-like.

#### SOLEIDAE

**Achirus achirus** (Linnaeus) "Linguado."

*Pleuronectes achirus* Linnaeus, Syst. Nat., ed. 10, pt. 1, 1758, p. 268 (type locality, Surinam).

*Achirus achirus* Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 278 (Contamana, Peru).

*Achirus lineatus* Fowler, Not. Nat. Acad. Nat. Sci. Phila., no. 35, Nov. 13, 1939, p. 9 (Kingston, Jamaica).

One, 102 mm., Lago Papary, Rio Grande do Norte. 1936.

#### MUGILIDAE

**Mugil curema** Valenciennes

*Mugil curema* Valenciennes, Hist. Nat. Poiss., vol. 11, 1836, p. (64) 87 (type locality, Brazil; Martinique; Cuba; Bahia).—Fowler, Proc. Acad. Nat. Sci. Phila., Jan. 13, 1904, p. 744 (not fig. 2) (Massachusetts; New Jersey; North Carolina; Florida; West Indies).—Eigenmann, Mem. Carnegie Mus., vol. 5, June 1912, p. 464 (Georgetown, British Guiana).—Fowler, Not. Nat. Acad. Nat. Sci. Phila., no. 35, Nov. 13, 1939, p. 9 (Kingston, Jamaica).

Three, 150 to 163 mm., Rio Jaguaribe, Russas, Ceará. 1937.

#### SCIAENIDAE

**Plagioscion squamosissimus** (Heckel) "Pescada."

*Sciaena squamosissima* Heckel, Ann. Wiener Mus., vol. 1, 1840, p. 438 (type locality, "Rio Negro und Rio Branco").

*Plagioscion squamosissimus* Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 280 (Contamana, Peru).

Two, 200 to 270 mm., Rio Parnahyba, Therezina, Piahy. 1936.

#### GERRIDAE

**Eucinostomus californiensis** (Gill)

*Diapterus californiensis* Gill, Proc. Acad. Nat. Sci. Phila., 1862, p. 245 (type locality, Cape San Lucas, Lower California).

*Eucinostomus californiensis* Fowler, Proc. Acad. Nat. Sci. Phila., vol. 81, March 3, 1930, p. 646 (Mazatlan; Panama); Not. Nat. Acad. Nat. Sci. Phila., no. 35, Nov. 13, 1939, p. 14 (Kingston, Jamaica).

*Eucinostomus pseudogula* Fowler, Proc. Acad. Nat. Sci. Phila., vol. 81, March 3, 1930, p. 646 (Bahamas; St. Martins; St. Croix; Rio Janeiro).

*Eucinostomus harengulus* Fowler, op. cit. (Florida; Bermuda; St. Domingo; Porto Rico; Jamaica; Costa Rica; Colon).

Two, 80 to 86 mm., Forteleza, Ceará. 1937.

**Diapterus olisthostomus** (Goode and Bean)

*Gerres olisthostoma* Goode and Bean, Proc. U. S. Nat. Mus., vol. 5, 1882, p. 423 (type locality, Indian River, Florida).

*Diapterus olisthostomus* Meek and Hildebrand, Field Mus. Publ., no. 226, zool. ser. vol. 15, pt. 2, April 15, 1925, p. 595 (Toro Point; Mindi Cut; Mindi Reef; Colon; Porto Bello, Panama).

One, 60 mm., Forteleza, Ceará. 1937.

**CICHLIDAE****Cichlasoma bimaculatum** (Linnaeus) "Acará."

*Labrus bimaculatus* Linnaeus, Syst. Nat., ed. 10, pt. 1, 1758, p. 285 (type locality, "in M. Mediterraneo" = Brazil?).

*Cichlasoma bimaculatum* R. von Ihering, Revista Mus. Paulista, vol. 7, 1907, p. 331 (Para; Matto Grosso; Brazil; Guiana; Trinidad).—Fowler, Proc. Acad. Nat. Sci. Phila., vol. 91, 1939 (Feb. 20, 1940), p. 280 (Contamana, Peru).

Five, 70 to 108 mm., Açude (artificial lake), Lima Campos, Icó, Ceará. 1936.

One, 110 mm., same locality. 1937.

Thirty, 50 to 70 mm., Rio Jaguaribe, Russas, Ceará. 1936.

Two, 57 to 59 mm., Forteleza, Ceará. 1937.

Two, 30 to 86 mm., Rio Choró, Ceará. 1936.

Two, 97 to 98 mm., Rio Salgade, Icó, Ceará. 1937.

One, 77 mm., Jatobá, Rio São Francisco, Pernambuco. 1936.

One, 46 mm., Campina Grande, Parahyba. 1936.

Eight, 71 to 183 mm., Lago Papary, Rio Grande do Norte. 1936.

Most of the above specimens with dark band from postocular back horizontally to black blotch above pectoral.

**Geophagus surinamensis** (Bloch)

*Sparus surinamensis* Bloch, Naturg. Ausland. Fische, vol. 5, 1791, p. 112, pl. 277, fig. 2 (type locality, "beigelegte Nahmen zeigt den Ort seines Aufenthalts an").

*Geophagus surinamensis* Eigenmann, Mem. Carnegie Mus., vol. 5, June 1912, p. 503, pl. 66, fig. 3 (British Guiana).—Fowler, Proc. Acad. Nat. Sci. Phila., April 1914, p. 277 (Rupununi R.); vol. 91, 1931 (Feb. 20, 1940), p. 289 (reference).

One, 98 mm., Forteleza, Ceará. 1937.

**Crenicichla saxatilis** (Linnaeus) "Jacundá."

*Sparus saxatilis* Linnaeus, Syst. Nat., ed. 10, pt. 1, 1758, p. 278 (type locality, Surinam).—Bonnaterre, Tabl. Ichth., 1788, p. 98, pl. 48, fig. 184 (Surinam).

*Crenicichla saxatilis* Eigenmann, Mem. Carnegie Mus., vol. 5, June 1912, p. 513 (British Guiana).

Four, 131 to 164 mm., Lago Papary, Rio Grande do Norte. 1936.

One, 120 mm., Rio Salgade, Icó, Ceará. 1937.

One, 146 mm., Rio Choró, Ceará. 1936.

Two, 112 to 222 mm., Rio Piancó, Rio Parahyba. 1936.

## ELEOTRIDAE

**Eleotris pisonis** (Gmelin)

*Gobius pisonis* Gmelin, Syst. Nat. Linn., pt. 1, 1789, p. 1206 (type locality, "in America australi"; on Gronow 1757 and Marcgrave 1648).

*Eleotris pisonis* Fowler, Proc. Acad. Nat. Sci. Phila., vol. 82, 1930, p. 275 (Grenada); vol. 83, 1931, p. 410 (Guanoco and Cano Guanoco, Venezuela); vol. 90, Oct. 24, 1938, p. 146 (Santiago and Guantanamo, Cuba).—Hildebrand, Field Mus. Publ., no 425, zool. ser. vol. 22, no. 4, Sept. 28, 1938, p. 347 (Panama).

*Culius perniger* Cope, Trans. Amer. Phil. Soc., vol. 14, 1871, p. 473 (type locality, St. Martin's, West Indies).—O'Shaughnessy, Ann. Mag. Nat. Hist., ser. 4, vol. 15, 1875, p. 146 (Bahia).

*Eleotris perniger* Fowler, Proc. Acad. Nat. Sci. Phila., Sept. 9, 1919, p. 142 (type).

One, 99 mm., Rio Choró, Ceará. 1936. Cheek entirely scaled.

**Dormitator maculatus** (Bloch) "Gobideos."

*Sciaena maculata* Bloch, Naturg. Ausland. Fische, vol. 6, 1792, p. 244, pl. 299, fig. 2 (type locality, "das Vaterland ist mir unbekannt" = West Indies).

*Dormitator maculatus* Jordan and Evermann, Bull. U. S. Nat. Mus., no. 47, pt. 3, 1898, p. 2196; pt. 4, 1900, pl. 324, fig. 782.—Fowler, Proc. Acad. Nat. Sci. Phila., 1919, p. 132 (Surinam); vol. 80, 1928, p. 466 (Guanica, Porto Rico); vol. 90, Oct. 24, 1938, p. 146 (Guantanamo and Santiago, Cuba).

Eleven, 40 to 90 mm., Rio Cocó, Ceará. 1936.

One, 112 mm., Forteleza, Ceará. 1936.

## GOBIIDAE

**Awaous taiasica** (Lichtenstein) "Gobideos."

*Gobius taissica* Linnaeus, Abhandl. Akad. Wiss. Berlin, 1822, p. 273 (type locality, Brazil).

*Awaous taiasica* Fowler, Proc. Acad. Nat. Sci. Phila., vol. 90, Oct. 24, 1938, p. 147 (Santiago, Cuba).

*Chonophorus taiasica* Fowler, op. cit., vol. 80, 1928, p. 466 (Guanica, Porto Rico), p. 473 (Dominica).

One, 167 mm., Rio Jaguaribe, Russas, Ceará. 1937.

Three, 120 to 190 mm., Forteleza, Ceará.

Two, 125 to 163 mm., Rio Choró, Ceará. 1936.

**Gobionellus oceanicus** (Pallas)

*Gobius oceanicus* Pallas, Spicilegia, 1770, pt. 8, p. 4 (type locality, unknown).—Jordan and Evermann, Bull. U. S. Nat. Mus., no. 47, pt. 3, 1898, p. 2230; pt. 4, 1900, pl. 328, figs. 789-789a.—Ribeiro, Revista Mus. Paulista, vol. 10, 1918, p. 782 (Santos; São João de Barra).

*Gobionellus oceanicus* Fowler, Proc. Acad. Nat. Sci. Phila., April 1919, p. 149 (Lucea, Jamaica); vol. 80, 1928, p. 462 (Haiti).

One, 233 mm., Forteleza, Ceará. 1936.





# A COMPARATIVE STUDY OF THE SUBFAMILIES OF THE ACRIDIDAE (ORTHOPTERA) PRIMARILY ON THE BASIS OF THEIR PHALLIC STRUCTURES

BY H. RADCLYFFE ROBERTS <sup>1</sup>

*Department of Zoology, University of Pennsylvania*  
*Research Associate, Academy of Natural Sciences of Philadelphia*

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## INTRODUCTORY DISCUSSION AND ACKNOWLEDGMENTS

This study was initiated by the discovery that evidence from the form of the phallic structures among the subfamilies of the Acrididae is in strong disagreement with the conventional classification of these groups. This is hardly surprising, since we may look in vain for any previous phylogenetic treatment, and those features, which have been used to distinguish the subfamilies, have been for the most part very superficial. Snodgrass (1935) and Walker (1922) have well described the phallic structures for certain examples of the Acrididae, and Chopard (1920) has considered examples

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<sup>1</sup> A dissertation presented to the Faculty of the Graduate School of the University of Pennsylvania in partial fulfillment of the requirements for the degree of doctor of philosophy.

from most of the subfamilies, but this latter author's treatment is inadequate for detailed comparisons. All these authors, however, were primarily concerned with the relationships of the Acrididae to other families and higher groups of the Orthoptera. On the other hand, Hubbell (1932), Hebard (1936), and Gurney (1940) have made valuable use of the form of the aedeagus in their systematic studies, but were chiefly concerned with species and subspecies differences within certain genera.

As has been noted by authors in the past, the phallus of the Acrididae is a relatively complex, specialized organ. In addition to this, considerable differentiation has now been found among the various subfamilies. The chief problem has, therefore, been to present first, a general description of the acridid phallus; second, a detailed treatment of the more distinctive forms of the subfamilies; and third, a brief treatment of a series of species from each subfamily to indicate the limits of variation or uniformity within the group. The problem of terminology became important during the course of this work, and in order to clarify the terms used and correlate those of other authors, a supplement treating them individually is added.

The development or specialization of certain features of the phallus can be observed by comparisons among the subfamilies. With this as evidence, together with observations by Slifer (1939, 1940a, 1940b) on the female reproductive system and other important evidence, it is now possible to point out certain definite subfamily relationships hitherto unrecognized, and at the same time present a general plan of their evolution, as indicated in the phylogenetic table. Aside from the desirability of confirming evidence from other sources, future study will be greatly needed to ascertain the status of a number of aberrant genera and generic groups within some of the subfamilies, especially the *Cryptacanthacridinae*.

I wish to acknowledge my appreciation to the Academy of Natural Sciences of Philadelphia for the many facilities made available to me, and to Mr. James A. G. Rehn and Mr. Morgan Hebard for their ever generous help and assistance. To Dr. C. E. McClung I am especially grateful for his valued advice and stimulating interest in this problem, and, for most helpful criticism in preparing the manuscript for press, I wish to thank him again, as well as Dr. H. B. Baker and other members of the Department of Zoology of the University of Pennsylvania. Further acknowledgments will be found throughout the paper.

#### METHODS OF STUDY

Since dried pinned specimens may be used for dissection, it has been possible to avail myself of the very extensive "Exotic Collection" (other than the United States and Canada) of the Academy of Natural Sciences of Philadelphia, containing about six hundred genera of Acrididae, and also

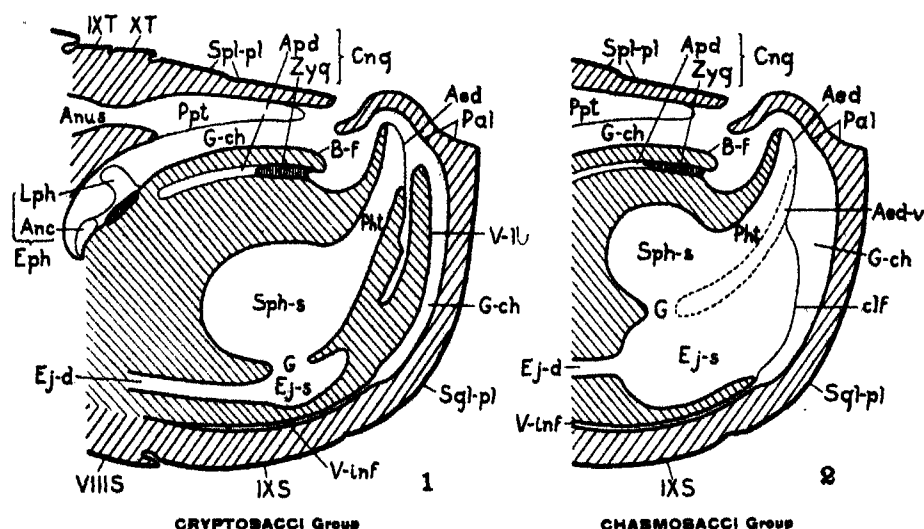
the very complete "Hebard North American Collection." From these collections representatives of nearly a hundred genera have been examined, which have been selected so as to give a fair cross-section of the whole family.

The method used for preparing the material for study is a relatively quick and simple one. The dried mounted specimen is suspended over a small tin dish of water by pinning to a board strip so that half of the abdomen is immersed in the water. The water is heated by an alcohol lamp and usually two to five minutes is sufficient to relax the abdomen and hind legs of the specimen, depending upon the size. By pushing the hind legs down, the end of the abdomen can be held between the thumb and index finger. Then a needle is used to depress the subgenital plate and pull back the pallium. The phallus together with the epiphallus may then be pulled out by inserting the needle under them. The membrane surrounding the base of the phallus must be cut or torn loose in order to remove the phallus from the specimen. Then the subgenital plate can be pushed back to its normal position and the specimen remounted so that it is entirely undamaged for future external studies. The phallus is heated in KOH and then by a little teasing the muscle and other tissues are removed leaving the membranes and sclerites clearly exposed. This material may be conveniently stored in small shell vials in alcohol. No study of the musculature has been undertaken at this time.

The drawings were made with the aid of a camera lucida. To facilitate comparisons, and as actual relative size seemed of little significance, all drawings of equivalent structures were kept relatively the same size. A legend is given with the drawings, however, to indicate the approximate magnification. Sclerotized portions are represented by stippling and membranes by hatching, so as to easily distinguish them. All pencil drawing was done by the author, but he is greatly indebted to Miss Helen Winchester, artist of the Academy of Natural Sciences of Philadelphia, for valuable assistance in part of the ink rendering.

#### GENERALIZED DESCRIPTION OF PHALLUS

Of the phallus, only the membraneous and sclerotized structures and the most important family modifications are described. For distinctive and detailed features of each subfamily, refer to the treatment of these beyond. For other descriptions of the phallic structures, refer to Snodgrass (1935) and Walker (1922). These authors used the Carolina locust, *Dissosteira carolina*, as the chief basis for their study. This species is also fully figured in this present paper, Figs. 75-80. Also refer to Chopard's (1920, pp. 186-194) descriptions of most of the subfamilies. Many differences in the termi-



Figs. 1-2.—Diagrammatic sagittal sections of the end of the male abdomen, representing the two major types of the phallus

#### EXPLANATION OF SYMBOLS FOR PLATES

VIII S	8th sternum	✓ Fur	Furcula
IX S	9th sternum	✓ G	Gonopore
I X T	9th tergum	✓ G-ch	Genital chamber
X T	10th tergum	× G-pr	Gonopore process
A-d-v	Arch of dorsal valves	× L-lb	Lateral lobe
Aed	Aedeagus	✓ Lph	Lophus
Aed-v	Aedeagal valve	× L-pl	Lateral plate of epiphallus
Anc	Ancora of epiphallus	× L-scl	Lateral sclerite of epiphallus
Anus	Anus	✓ Pal	Pallium
Apd	Apodeme of cingulum	✓ Pht	Phallotreme
art	Articulation	✓ Ppt	Paraproct
B-f	Basal fold	× Ret	Rectum
Br	Bridge of epiphallus	× Rm	Ramus of cingulum
Cer	Cercus	× Sh	Sheath of aedeagus
clf	Cleft	✓ Sgl-pl	Subgenital plate
Cng	Cingulum	✓ Sph-s	Spermatophore sac
D-v	Dorsal valve of aedeagus	✓ Spl-pl	Supra-anal plate
Ej-d	Ejaculatory duct	✓ V-inf	Ventral infold
Ej-s	Ejaculatory sac	✓ V-lb	Ventral lobe
Enph-pl	Endophallic plate	× V-v	Ventral valve of aedeagus
Eph	Epiphallus	✓ Zyg	Zygoma of cingulum
fix	flexure		

nology used by Snodgrass, Walker, and Chopard are evident. For a description of the terms followed here and comparison of those used by these authors, refer to the supplement of this paper. Concerning the phallic muscles, no description is given here, but Ford (1924, pp. 283-299) and Snodgrass (1935, pp. 67-69) give us information on some species of the family.

The term phallus is used for the whole structure directly concerned with the transfer of sperm to the female spermatheca. The term aedeagus is used only for the distal or caudal portion of the phallus. The aedeagus functions as the intromittent part, whereas the main body is more concerned with the formation of the spermatophore and as a pumping mechanism. The epiphallus is a relatively separate sclerite developed from the basal fold (B-f) membrane and lies on the dorso-cephalic part of the phallus. It functions to pull down the female subgenital plate and depress the male supra-anal plate (Spl-pl).

The phallus occupies the whole end of the abdomen and when removed appears as a heavily muscled, bulb-like organ. The aedeagus, the neck of the bulb-like shape, and forming the caudal end of the phallus, is strongly up-curved. In the normal, retracted position of the phallus, Figs. 1-2, the aedeagal portion is covered over by the pallium (Pal) and the dorsum of the main body by the paraprocts (Ppt) and the supra-anal plate (Spl-pl). In copulation, the phallus is projected dorsad so that the aedeagus and dorsum of the phallus is exposed, and the supra-anal plate becomes depressed so that its apex is anterior to the epiphallus. For detailed descriptions of the process of copulation, refer to Kyl (1938), Snodgrass (1935, p. 71), Boldyrev (1929), and others.

Figs. 1 and 2 are very diagrammatic sagittal sections of end of abdomen, intended to show the relative position of the phallus to the external, abdominal sclerites, the relative position of the internal ducts and cavities of the phallus, and the form of these ducts and cavities as they occur in the two primary groups of the family. Fig. 1 represents one of the two major groups of subfamilies and for convenience is referred to as the Cryptosacchi (or closed ejaculatory sac) Group. Fig. 2 represents the other group of subfamilies and is called the Chasmosacchi (or open ejaculatory sac) Group. The various phallic sclerites have been little if at all indicated in these figures. For illustration of these structures and other details, refer to Figs. 3-8 and Figs. 75-80, which may be taken as characteristic examples of the Chasmosacchi and Cryptosacchi respectively.

The principal internal features of the phallus are the ejaculatory duct (Ej-d), the two cavities called the ejaculatory sac (Ej-s) and the spermatophore sac (Sph-s) which are connected by the gonopore (G), and lastly

the duct that leads out through the aedeagus and called the phallotreme (Pht). These ducts and cavities are lined by a membrane which may be called the inner or endophallic membrane. From this, the endophallic sclerites are derived. The outer covering membrane is termed the ectophallic membrane, and from this the ectophallic sclerites are derived. The ejaculatory sac of the Cryptosacci, Fig. 1, is a relatively small cavity and usually to be found flattened against the spermatophore sac (Sph-s) and its sclerites. The gonopore (G) is the opening which directly connects the ejaculatory sac with the spermatophore sac. In the Chasmosacci, Fig. 2, the ejaculatory sac is much larger and has a median cleft (clf) at its caudal end which opens into the genital chamber (G-ch) or to the exterior (see also clf, Fig. 6). A gonopore is evident, but there is also a slit-like connection between these two cavities all along the mid-ventral line of the spermatophore sac and phallotreme. This connection is normally closed, however, by the close apposition of the ventral portions of the aedeagal valves (Aed-v, shown by broken lines). A probe, if introduced into the phallotreme and well back into the spermatophore sac, may be pressed down so that it passes between the aedeagal valves (Aed-v) and down to the floor of the ejaculatory sac (Ej-s) and protrudes from the ventral end of the cleft (clf) of the ejaculatory sac. This procedure is of course not possible in the case of the Cryptosacci, as may be seen from Fig. 1. The functional significance of these differences in form is not yet understood.

A The pair of large and often complex endophallic sclerites are derived from the membranes of the spermatophore sac and phallotreme, and partly flank this cavity and duct. They are composed of two relatively distinct parts: the caudal portions forming the aedeagal valves (Aed-v), chiefly derived from the phallotreme membrane; the cephalic portions forming the endophallic plates (Enph-pl), derived from the spermatophore sac membrane. The point of demarcation between these two parts is usually indicated by a point of articulation (art, Fig. 22) or a constricted region of flexure (flx, Fig. 77). In the Pyrgomorphinae (Fig. 7) and the Ommexechinae (Fig. 37), however, the aedeagal valves and the endophallic plates are rigidly continuous. In the Chasmosacci, there are but one pair of valves and, as already mentioned, they are not connected by a membrane along the mid-ventral line of the phallotreme. Among the Cryptosacci, there are usually two (dorsal and ventral) pair of aedeagal valves (D-v and V-v, Fig. 77). The proximal or cephalic portion of the dorsal valves is often firmly attached to part of the ventral valves. These dorsal valves do not continue cephalad to join the endophallic plates, but rather give rise to a sclerotized dorsal projection called the arch of the dorsal valves (A-d-v, Figs. 77, 78) which connects with the median portion of the zygonia (Zyg)

of the cingulum. The endophallic plates (Enph-pl, Figs. 7, 22, 77) lie partly laterad to the spermatophore sac and always extend some distance beyond it cephalad. This portion always has heavy muscle attachments. Usually the endophallic plates have a pair of projections which lie laterad to the gonopore (G) to form what are called the gonopore processes (G-pr, Fig. 77) and these function as valves to open and close the gonopore, as described by Snodgrass (1935, p. 69).

The outer or ectophallic membrane covers the exposed part of the phallus in the genital chamber (G-ch) and is actually continuous with that lining the genital chamber. The ectophallic membrane gives rise to the various outer or superficial sclerites of the phallus. This membrane merges with the endophallic membrane at the opening of the phallotreme or phallotreme cleft and also at the ejaculatory sac cleft (clf) in the Chasmosacci. These two membranes are not fundamentally different for they are both ectodermal derivatives, but they are convenient divisions in considering the structures arising from each. The ectophallic membrane forms the outer covering or sheath (Sh) of the aedeagus and may actually form part of the aedeagal valves where these are exposed externally. In certain genera, e.g. the genus *Melanoplus* of the Cyrtacanthacridinae, this sheath becomes much folded or lobed to form a very complex aedeagus. At the proximal edge of the sheath the ectophallic membrane is developed into a collar-like sclerite which may almost completely surround the base of the aedeagus except along the mid-ventral line. Each lateral portion of this structure is called a ramus (Rm, Figs. 3, 4, 77). These rami form only a part of the sclerite called the cingulum. The dorsal part of this "collar" is called the zygoma (Zyg, Figs. 4, 20, 41, 61, 76). The cephalic part of the zygoma is formed by an invagination of the ectophallic membrane, and from the latero-cephalic edges of the zygoma are produced two deeply invaginated processes, the apodemes (Apd, Figs. 4, 20, 41, 60, 76). If the cingulum were flattened out, it might be very diagrammatically represented as a letter "H". The upper projections of the letter would represent the apodemes; the cross bar, the zygoma; and the lower projections, the rami, which embrace the base of the aedeagus. The Chasmosacci have a much simpler development (see Fig. 4) and apparently represents the more primitive form. Here the cingulum suggests a sclerotized capsule surrounding much of the dorsum and sides of the phallus. This is due to the very thin, broad form of all of its elements. The basal fold (B-f), Fig. 1, is the large fold of the ectophallic membrane which arises from near the caudal edge of the zygoma of the cingulum and turns back over the whole dorsum of the phallus. The epiphallus (Eph) lies usually in the anterior part of this basal fold.



Comparable to the dorsal invagination of the ectophallic membrane, forming the cephalic part of the cingulum, is the ventral infold (V-inf, Figs. 1, 2, 5, 19, 40, 78). This is usually a broad membranous invagination that extends under most of the ventrum of the phallus. In the Chasmosacci, it is especially large and in some cases may be sclerotized on the dorsal wall of the fold, complementing the capsule-like form of the cingulum on the dorsum and sides of the phallus. In the Cryptosacci, it is much reduced, never sclerotized, and may be easily overlooked in a dissection. The function of this ventral infold is merely that of a sheath separating certain muscles and for muscle attachments. The opening of the ventral infold into the genital chamber does not extend sufficiently laterad to allow the fold to open up when the phallus is projected dorsad in copulation. Ford (1924, Fig. 45) appears to be the first and only author to illustrate this ventral infold and refers to it (p. 296) simply as the subgenital sac.

In the Chasmosacci, there are usually a pair of lateral lobes (L-1, Figs. 3, 17) lying beside the phallus below the basal fold. Whether these are the forerunners of the ventral lobe in the Cryptosacci is open to question. However, the ventral lobe (V-1, Figs. 2, 75) lies in a comparable position except that it forms a single fold around the ventral side of the aedeagus. This ventral lobe is often partly sclerotized. In the Cyrtacanthacridinae, it may be either absent, e.g. in *Melanoplus* and its allies, or present, e.g. in *Schistocerca* and its allies.

The function and position of the epiphallus (Eph) has already been mentioned. There are at least three general forms of this structure. One of these is found in the Pyrgomorphinae (Figs. 8, 13-16); another in the Pamphaginae and its allied subfamilies (Figs. 23, 31-36); and the third among the subfamilies of the Cryptosacci (Figs. 70-74, 86-90). I have used certain terms for the various parts of the epiphallus as they occur in the Cryptosacci (Figs. 43, 80). The more important of these features are: the ancorae (Anc), a pair of hook-like structures on the anterior margin of the epiphallus; the lophi (Lph), a pair of crest-like structures that have some grasping function; and the lateral sclerites (L-scl, Fig. 75), which are usually a pair of small, separate sclerites on either side of the main body of the epiphallus and serve for muscle attachment. These lateral sclerites may be absent or obsolete in certain groups, but even when present they have usually been omitted from the drawings. The homologues of the various parts of the epiphallus, mentioned above, are not clear in the form of the epiphallus found in the Pyrgomorphinae and Pamphaginae. By future study of the muscle attachments on this structure it may be possible to work out the homologous parts.



## DESCRIPTION OF THE PHALLIC STRUCTURES OF THE SUBFAMILIES

## (Group Chasmosacci)

## Subfamily PYRGOMORPHINAE

*Phymateus morbillosus* (Linnaeus)<sup>2</sup>

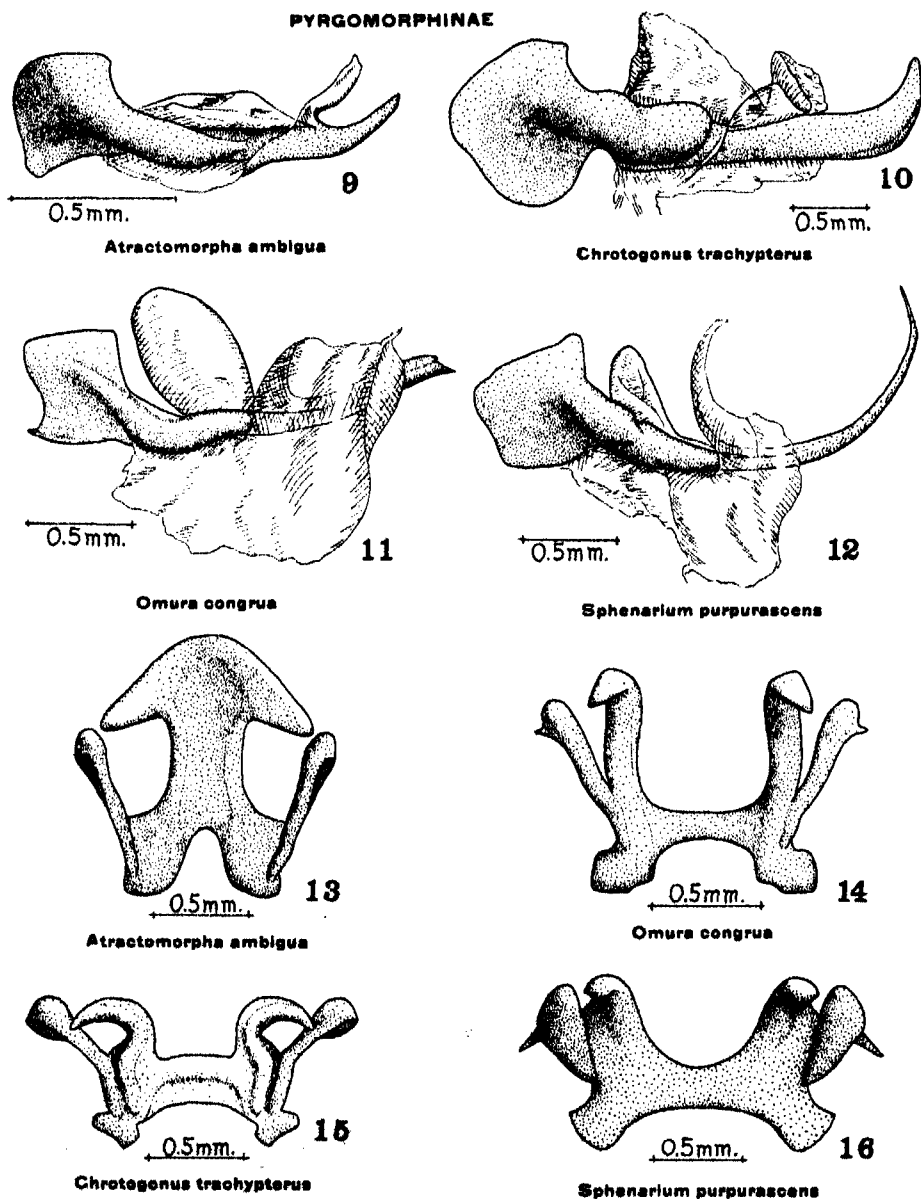
Figs. 3-8.

This particular species selected for illustration belongs to a rather distinctive group of genera within the subfamily, at least in respect to the external appearance and structure. Its large size, however, greatly facilitates dissection and study, and, at the same time, the general form of the phallus is characteristic of the subfamily.

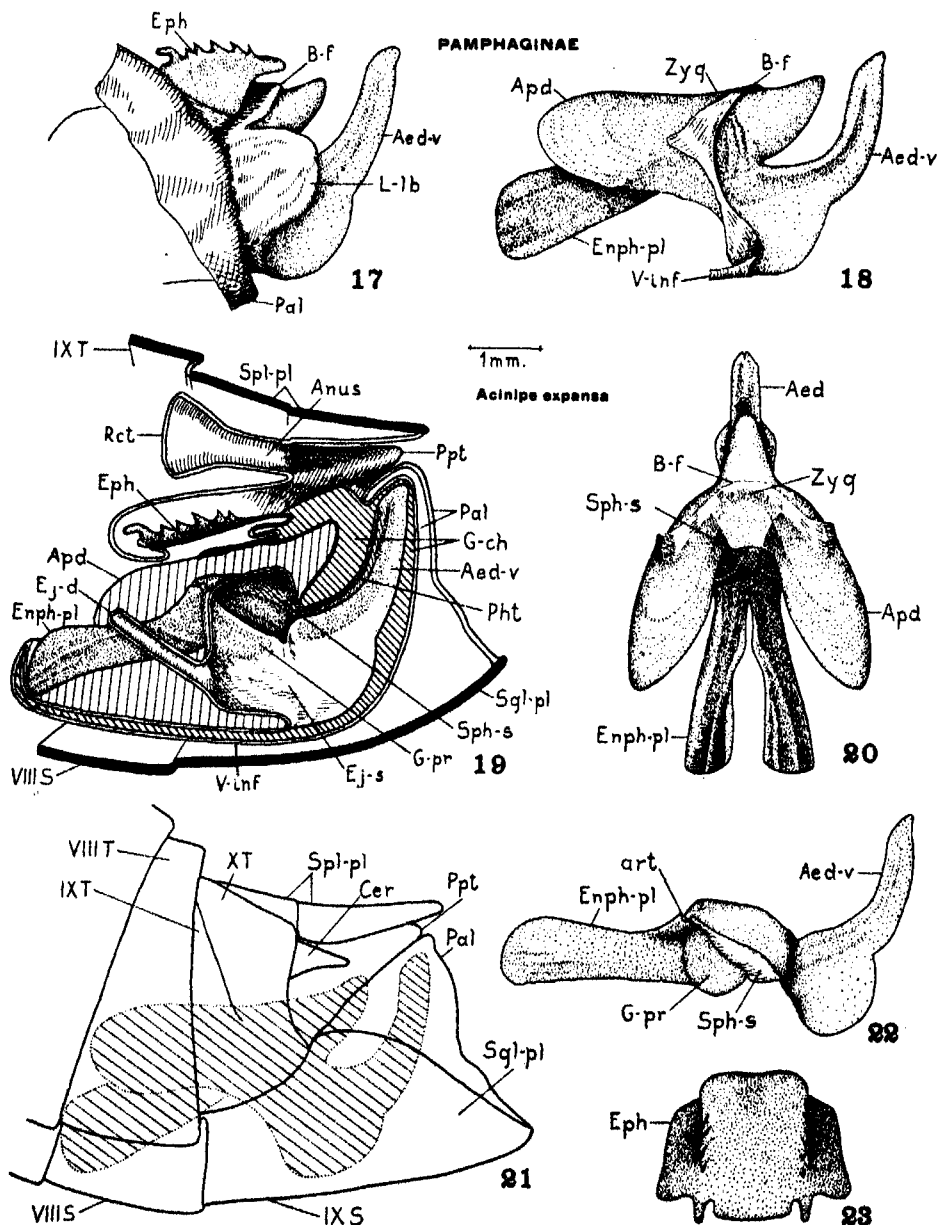
The phallus is of the open ejaculatory form and hence of the Chasmosacci Group. The more outstanding features are the following: The very large ejaculatory sac (Ej-s) has an opening at its caudal end and is most clearly shown in Fig. 6 (clf), where it appears as a deep median cleft, extending ventrad from the aedeagal valves (Aed-v). The spermatophore sac (Sph-s), Figs. 5 and 7, lies dorsad of the aedeagal valves and endophallic plates (Enph-pl). The spermatophore sac and phallotreme (Pht) are separated from the ejaculatory sac by the close apposition of the ventral portion of the aedeagal valves. However, the aedeagal valves may be easily pushed apart. The actual gonopore (G), Fig. 5, or usual connection between the ejaculatory sac and the spermatophore sac, is at the base of the aedeagal valves. There is but a single pair of aedeagal valves present, Fig. 7, and these are rigidly connected with the endophallic plates, thus preventing independent movement or articulation between the aedeagus and the endophallic plates. There are a pair of small, sclerotized lobes or processes which are seen just cephalad and dorsad to the exposed part of the aedeagal valves, Figs. 5 and 6. These might be taken to be the forerunners of the dorsal pair of valves, found in most other subfamilies, but of this I am very doubtful, and they certainly form no part of the phallotreme duct. The cingulum may be said to form a sclerotized capsule about the dorsal and lateral portions of the phallus, and the principal parts of the cingulum, i.e. apodemes (Apd), zogoma (Zyg), and rami (Rm), Figs. 3 and 4, are very poorly differentiated. Also, there is no sclerotized connection between the cingulum and the aedeagal valves. The ventral infold (V-inf), Fig. 5, is very greatly developed and covers the whole ventral surface of the phallus. Small lateral lobes (L-lb), Fig. 3, are present and these may be the fore-

<sup>2</sup> The species of this genus are in a state of uncertainty and, to avoid possible doubt as to the material studied, the following data are given. Most readily distinguished by the green pronotum and very greatly inflated pair of tubercles on the prozona. Collected between Fraserburg and Fraserburg Road, Cape Province, Union of South Africa, March 20, 1939, by C. E. McClung and E. R. Helwig. In connection with this species and several others from South Africa, acknowledgement is due to the American Philosophical Society for making the collection possible in part by a grant to Dr. McClung.

## PYRGOMORPHINAE



Pygomorphinae. Figs. 9-12.—Lateral aspect of endophallic sclerites (sedeagus and endophallic plate) and spermatophore sac. Ejaculatory duct and most of ejaculatory sac removed. Figs. 13-16.—Epiphalli.



*Acinipe expansa* (Pamphaginae). Fig. 17.—Lateral aspect of caudal part of phallus. Fig. 18.—Lateral aspect of phallic sclerites with membranes, muscles and other tissues removed. Fig. 19.—Sagittal section of end of abdomen, showing sclerites and membranous structures. Diagonal ruled lines represent genital chamber and cavity of

runners of the ventral lobe, so prominent in certain genera of other subfamilies. The epiphallus, Fig. 8, is very distinctive and its parts have not been homologized with certainty with those of other subfamilies. What I have labelled as the lophi (Lph) may possibly be the *ancorae*, and the lateral plates (L-pl) actually the lateral sclerites. A study of the associated muscles may clarify these homologies.

*Species Examined*

*Atractomorpha ambigua* Bolivar, Figs. 9, 13.

*Chrotogonus trachypterus* (Blanchard), Figs. 10, 15.

*Dictyophorus* sp.

*Ichthyotettix mexicanus* (Saussure).

*Omura congrua* Walker, Figs. 11, 14.

*Poeciloceris pictus* (Fabricius).

*Phymateus saxosus* Coquebert.

*Phymateus morbillosus* (Linnaeus), Figs. 3-8.

*Sphenarium purpurascens* Charpentier, Figs. 12, 16.

? *Xyronotus aztecus* Bolivar.

The above species conform well, except for *Xyronotus aztecus*, as indicated by a query. This species is certainly not a pyrgomorph on the basis of its phallic structure, and it has 23 chromosomes<sup>3</sup> (male diploid) instead of the usual 19 of the Chasmosacci. Dr. Eleanor H. Slifer tells me (in litt.) that the species conforms with the Pyrgomorphine, however, in respect to the spermatheca and the absence of glandular pouches in the female. Though the external form shows some most peculiar features, it is still very suggestive of a pyrgomorph. Future study is planned on this species, and, though the phallic structure agrees with no recognized subfamily, for convenience I would suggest allowing it to remain within the Pyrgomorphinae for the present.

Comparing the drawings of the endophallic sclerites of the species selected from the above list, including *Phymateus*, they exhibit a remarkable similarity, considering the distinctive external form of each species. The single pair of aedeagal valves, which are rigidly attached to the endophallic plates, and the dorsal position of the spermatophore sac are most diagnostic. The drawings of the epiphallus indicate considerable diversity of form, but still the general plan is quite evident.

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<sup>3</sup> I am indebted to Dr. E. R. Helwig for this information.

---

ventral infold. Vertical ruled lines represent space in phallus occupied by muscle and other tissues. Fig. 20.—Dorsal aspect of phallic sclerites, as shown in Fig. 18. Fig. 21.—Lateral aspect of end of male abdomen with outline of phallic sclerites (Fig. 18) superimposed to show relative position. Fig. 22.—Lateral aspect of endophallic sclerites. Fig. 23.—Epiphallus.

## Subfamilies PAMPHAGINAE, BATRACHOTETRIGINAE, and THRINCINAE

*Acinipe expansa* (Brunner)

Figs. 17-23.

The phallic structures found in these subfamilies are essentially so similar that they are best described together. *A. expansa* of the subfamily Pamphaginae is selected for illustration because it is moderately large and at the same time closely related to *Pamphagus elephas*, the subfamily type. Though the Pamphaginae are distinctive in many features, *Acinipe* shows the following important similarities to the Pyrgomorphinae: an open ejaculatory sac; one pair of aedeagal valves (Aed-v), cf. Figs. 7, 22, not connected with each other on their mid-ventral line, but lying in close apposition; spermatophore sac (Sph-s), cf. Figs. 5, 19, chiefly dorsad of the base of the aedeagal valves; cingulum, especially the apodemes (Apd), cf. Figs. 4, 20, broad, plate-like; ventral infold (V-inf), cf. Figs. 5, 19, very large and may be partly sclerotized.

The pamphagines are distinguished from the pyrgomorphs by the well defined articulation (art), Fig. 22, between the proximal end of the aedeagal valves and the dorso-posterior portion of the endophallic plates (Enph-pl). The ventro-posterior portion of the endophallic plates form a pair of gonopore processes (G-pr), Fig. 22. The whole external part of the aedeagus is sclerotized and merges into the cingulum. The proximal part of the sclerotized portion may be said to represent the rami of the cingulum and firmly supports the aedeagal valves. The simplest diagnostic feature is the form of the epiphallus, Fig. 23, which may readily be seen by pulling the phallus part way out after relaxing any pinned specimen. I have thus far not encountered this form of epiphallus in other subfamilies. This structure frequently covers most of the dorsum of the phallus. The two lateral, longitudinal rows of spines, and pair of hooks (ancorae?) on its anterior margin are characteristic.

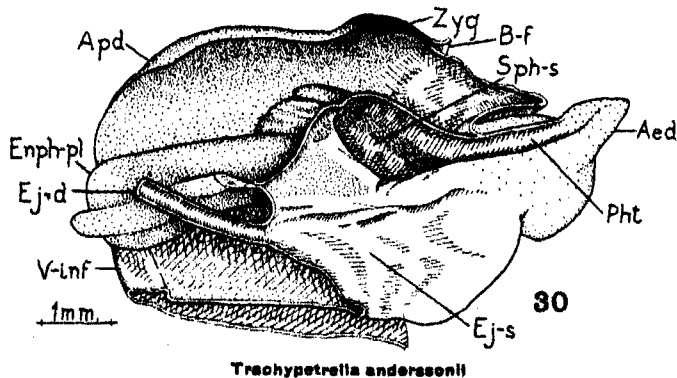
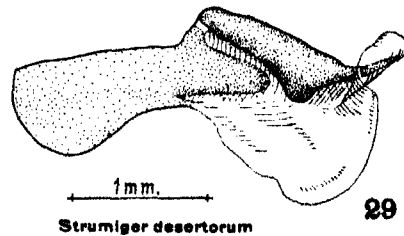
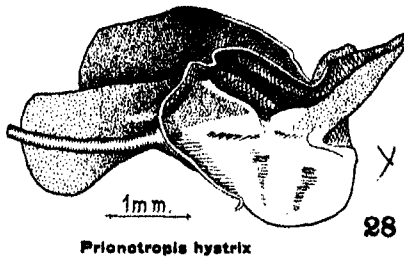
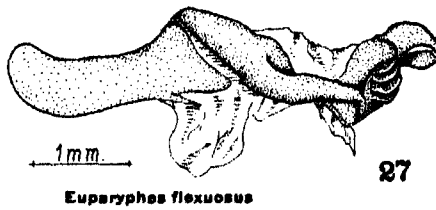
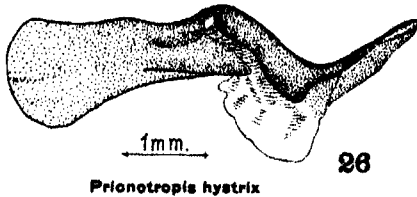
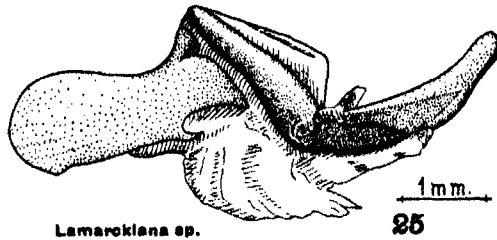
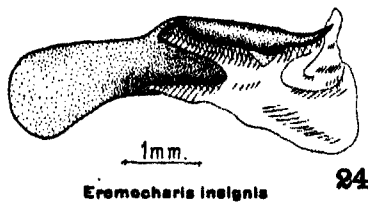
*Species Examined*

## PAMPHAGINAE

*Acinipe expansa* (Brunner), Figs. 17-23.*Euparyphes flexuosus* Bolivar, Figs. 27, 34.*Lamarckiana* sp., Figs. 25, 35.*Pamphagus elephas* (Linnaeus).*Tropidauchen securicollis* Saussure.

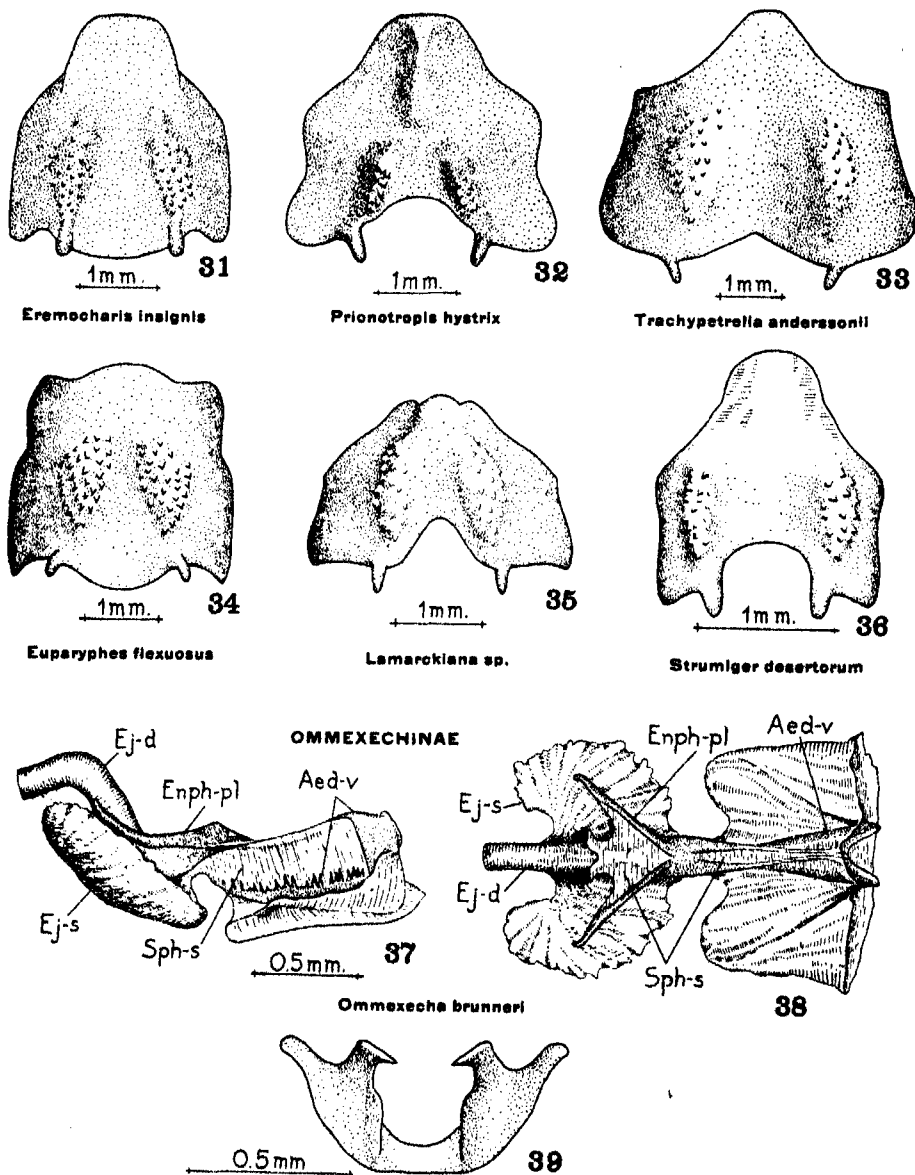
## BATRACHOTETRIGINAE

*Eremocharis insignis* (Lucas), Figs. 24, 31.*Eremopeza c. cinerascens* (Stål).*Prionotropis h. hystrix* (Germar), Figs. 26, 28, 32.*Tmethis tartarus* (Saussure).*Trachypetrella anderssonii* (Stål), Figs. 30, 33.



Pamphagine subfamilies, including Batrachotetriginæ and Thrincinæ. Figs. 24-27, 29.—Lateral aspect of endophallic sclerites. Figs. 28-30.—Sagittal section of phallus, showing sclerites and membranous structures, excepting basal fold removed in both figures and ventral infold removed in Fig. 28.





Figs. 31-36.—Epiphalli of pamphagine subfamilies. Figs. 37-39.—*Ommexechea brunneri* (Ommexechinae). Fig. 37.—Lateral aspect of endophallic sclerites and membranous structures with part of large pouch below aedeagus (cf. Fig. 38) removed. Fig. 38.—Dorsal aspect of endophallic sclerites and membranous structures. Fig. 39.—Epiphallus.

## THRINCINAE

*Strumiger desertorum* Zubowsky, Figs. 29, 36.*Thrincus campanulatus* Fischer de Waldheim.

All of the above species were found to conform closely to each other. The differences in the form of the aedeagus, as shown in the figures, is considered of only generic significance.

(Group **Cryptosacci**)

## Subfamily OMMEXECHINAE

**Ommexechea brunneri** Bolivar

Figs. 37-39.

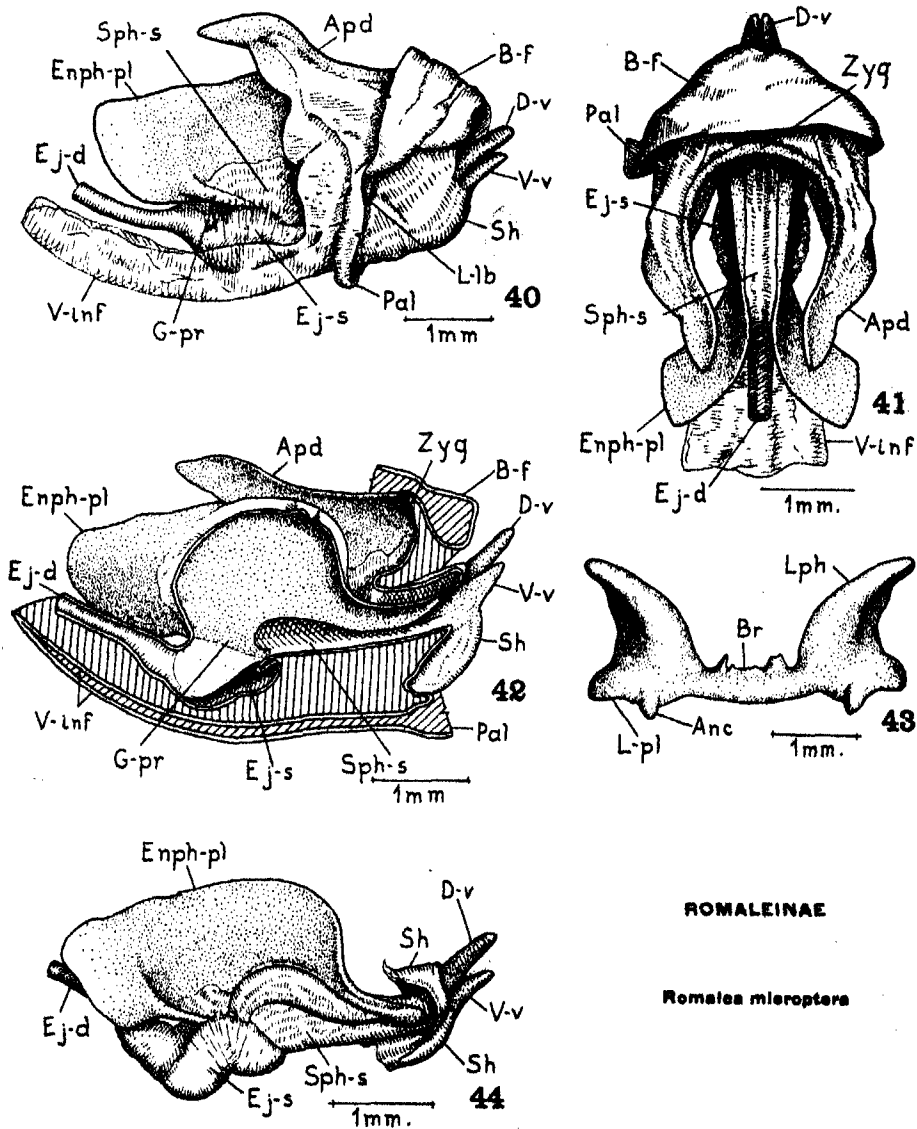
This species together with *Ommexechea servillei* Blanchard, *Parossa viridis* (Giglio-Tos), and *Spathalium klugii* (Burmeister) have been examined and found to have very similar phallic structures. The general form of the phallus is very distinctive from that in any other subfamily examined. The ejaculatory sac (Ej-s) is very large, but certainly of the closed form (Cryptosacci Group). The endophallic plates (Enph-pl) are reduced to little more than a pair of small processes extending dorso-cephalad. Their ventral portion is developed into a pair of gonopore processes (not shown in figures). The limits of what may be considered the spermatophore sac (Sph-s) are not altogether clear. The dorso-proximal portion of what may be called the aedeagal valves or sclerites (Aed-v) merge with the endophallic plates (Enph-pl). These aedeagal sclerites open along their distal and disto-ventral margin, and there is a large pouch connected with the ventral margins of these sclerites and which folds against their sides. The function of this pouch is unknown. The cingulum is reduced to a simple pair of sclerites on the dorso-lateral parts of the ectophallic membrane, so that it is hardly recognizable. There is apparently no ventral infold present unless the pouch beneath the aedeagus may be so considered. The epiphallus, Fig. 39, has a distinctive form. Further studies on this group and other peculiar South American species may aid in the understanding of this very divergent form of the phallus.

## Subfamily ROMALEINAE

**Romalea microptera** (Beauvais)

Figs. 40-44.

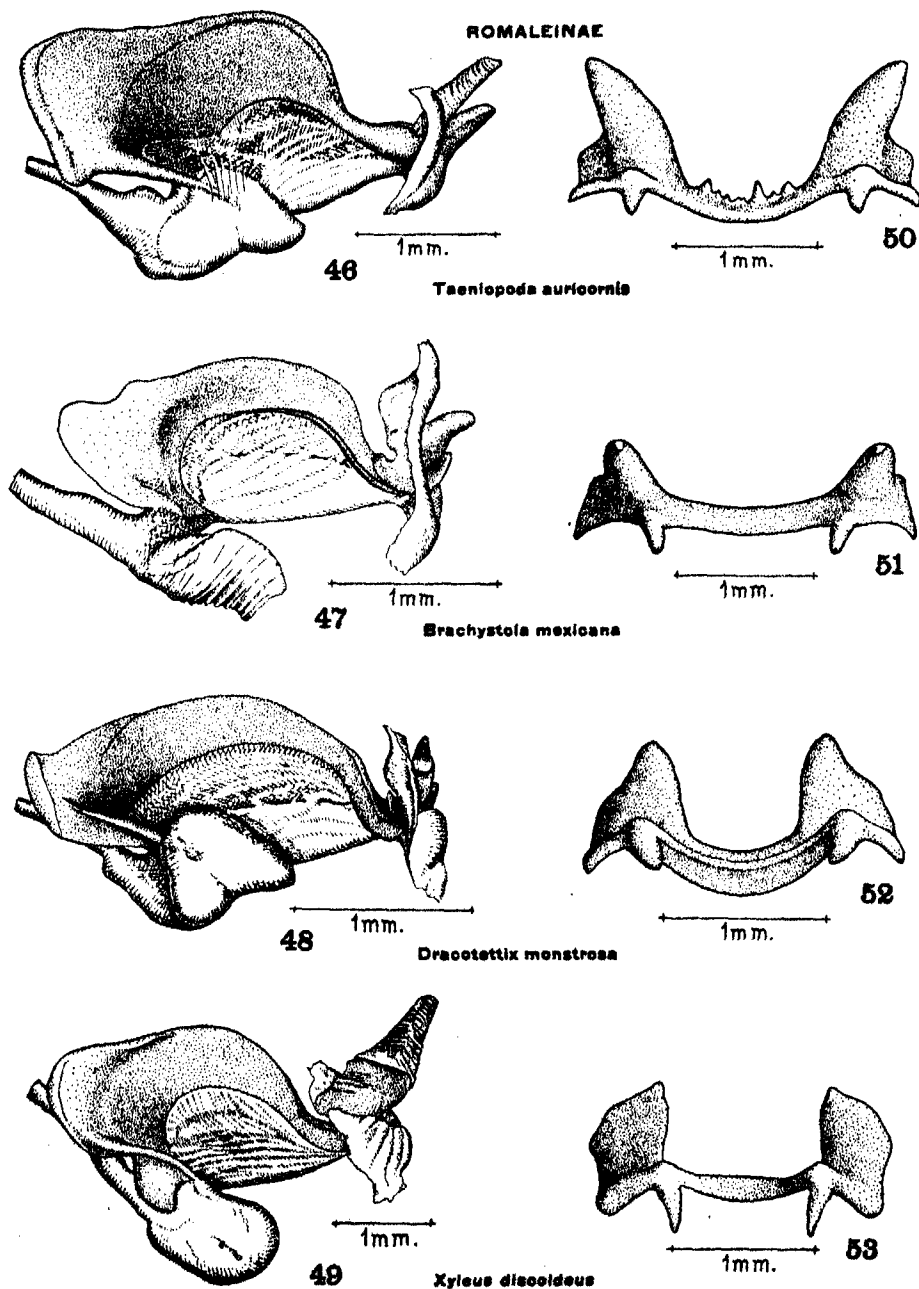
This species has been figured by Snodgrass (1935, p. 80). The more outstanding features are the following: It has the closed ejaculatory sac. The endophallic plates (Enph-pl), Fig. 44, are relatively large with their caudal ends produced to form rigid processes that support the base of the aedeagus. The dorsal and ventral pairs of aedeagal valves (D-v, V-v) are relatively short and form four independently moving processes and are closely connected with the ends of the endophallic plates. Of special im-



## ROMALEINAE

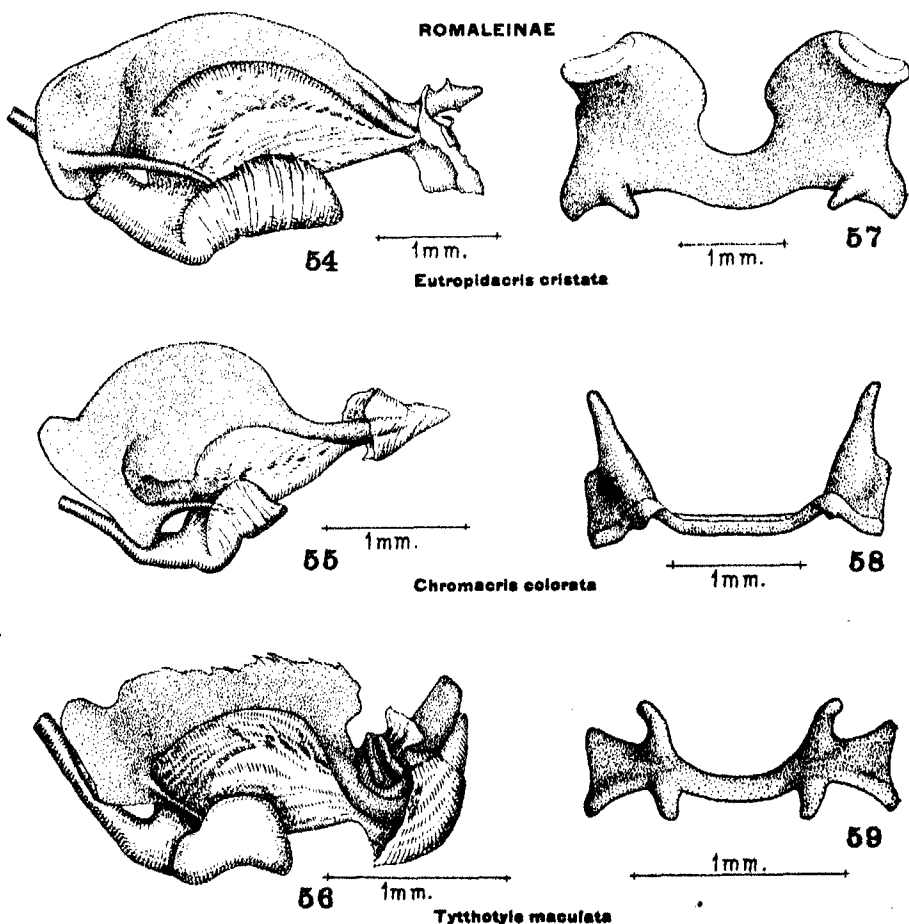
*Romalea microptera*

*Romalea microptera* (Romaleinae). Fig. 40.—Lateral aspect of sclerites and membranous structures of phallus, excepting cephalic part of basal fold, which is removed. Fig. 41.—Dorsal aspect of same. Fig. 42.—Sagittal section of phallus, showing sclerites and membranous structures. Fig. 43.—Epiphallus. Fig. 44.—Lateral aspect of endophallic sclerites and membranous structures.



Romaleinae. Figs. 46-49.—Lateral aspect of endophallic sclerites and membranous structures. Figs. 50-53.—Epiphalli.

portance is the absence of a sclerotized connection between the base of the dorsal aedeagal valves and the median portion of the zygoma (Zyg), Fig. 42, of the cingulum; i. e., there is no arch of the dorsal aedeagal valves, characteristic of the subsequently treated subfamilies. The apodemes (Apd), Figs. 40, 41, of the cingulum are relatively broad or plate-like, though in this particular species they are much narrower than in most other species encountered in this subfamily. The ventral infold (V-inf), Figs. 40, 42, is larger than that of other subfamilies of the Cryptosacci. The general form of the epiphallus, Fig. 43, is distinctive and can not be confused with those of other subfamilies except the Cyrtacanthacridinae.



Romaleinae. Figs. 54-56.—Lateral aspect of endophallic sclerites and membranous structures. Figs. 57-59.—Epiphalli

## Other Species

Figs. 46-59.

For a list of those species considered to belong to this subfamily and those dissected for study, refer to the latter part of this paper under "Genera of the Romaleinae." The endophallic sclerites of the seven species figured conform closely to a general pattern. Several of the species have a much reduced ventral pair of aedeagal valves and in *Chromacris*, Fig. 45, the ventral pair is represented by membrane only and the dorsal pair is entirely lacking. Some of the species examined show various modified forms of the apodemes of the cingulum, but they never become rod-like as shown for *Paulinia*, Fig. 60, or *Dissosteira*, Fig. 79. One peculiarity that I have not encountered in other subfamilies is the transverse sculpturing on the dorsal aedeagal valves, shown in Figs. 46, 48, 49, and 54. The illustrations of the epiphallus show considerable diversity.

## Subfamily PAULINIINAE

*Paulinia acuminata* (De Geer)

Figs. 60-62.

The general form of the phallus of *Paulinia* shows a close resemblance to that of certain species of the subfamily Cyrtacanthacridinae. However, this form of phallus is quite distinctive from any of those species of the Cyrtacanthacridinae that are used here for illustration. The more characteristic features are the following: The dorsal part of the endophallic plates (Enph-pl) flare very strongly laterad as seen in dorsal aspect, Fig. 61. The aedeagus is short with the dorsal and ventral valves (D-v, V-v) stout, rod-like sclerites. The proximal portion of the dorsal aedeagal valves is very heavily developed to form the arch of the aedeagal valves (A-d-v). The cingulum in contrast is relatively reduced and its apodemes (Apd) are weak, slender, parallel processes. Again the epiphallus, Fig. 62, has an unusual form and the homologies of its parts are not clear. Its form, however, is perhaps an adaptation to the unusual shape of the subgenital plate in the female. I have not examined *Morellia*, the one other genus placed in this subfamily.

## Subfamily CYRTACANTHACRIDINAE

*Species Examined*

- ?*Abracris obliqua* (Thunberg).
- ?*Betiscoides meridionalis* Sjöstedt.
- Bibracte hagenbachii* (De Haan).
- Calliptamus italicus* (Linnaeus), Figs. 67, 73.
- Catantops humilis* (Serville), Figs. 69, 74.
- ?*Coscineuta virens* (Thunberg).
- Dactylotum pictum* (Thomas).
- Dendrotettix quercus* Riley.

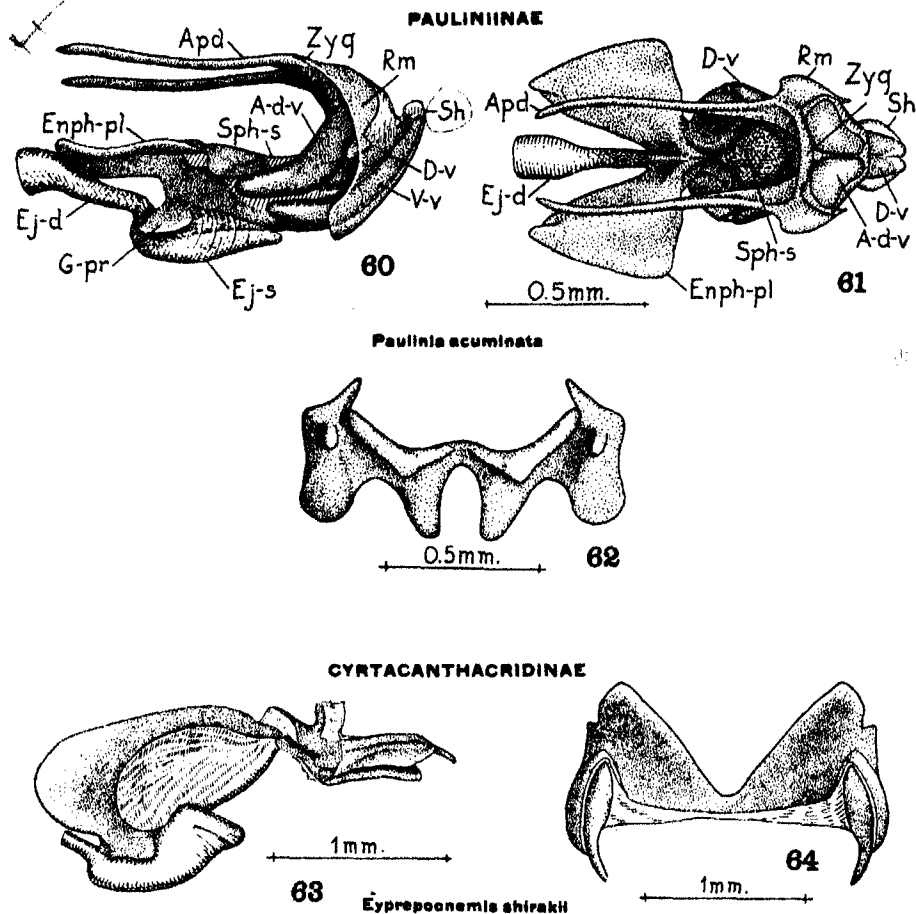
*Dericorys millierei* Bonnet & Finot.  
*Euthymia fasciata* (Walker).  
*Eyprepocnemis shirakii* Bolivar, Figs. 63, 64.  
*Goniaea australasiae* (Leach).  
*Hieroglyphus banian* (Fabricius).  
*Hesperotettix viridis* (Thomas).  
*?Ischnacrida pallida* (Burmeister).  
*?Leptysma marginicollis* (Serville).  
*Melanoplus femur-rubrum* (De Geer), Figs. 66, 70.  
*Ommatolampis perspicillata* (Johansson).  
*?Osmilia flavolineata* (De Geer).  
*Orya vicina* Brunner.  
*Pezotettix giornae* (Rossi).  
*?Phaeoparia rotundata* (Stål).  
*Philocleon nigrovittatus* (Stål).  
*Podisma carpetana* Bolivar.  
*Proctolabus brachypterus* Bruner.  
*Schistocerca americana* (Drury), Figs. 65, 71.  
*Spathlosternum prasiniferum* (Walker).  
*Teratodes brachypterus* (Bolivar).  
*Tetrataenia surinama* (Linnaeus).  
*Tristria pulvinata* Uvarov.  
*Tropidopola longicornis graeca* Uvarov.  
*Tyloptropidius varicornis* (Walker).  
*Vilerna aeneo-oculata* (De Geer).  
*Zyglocistron trachystictum* Rehn.

The above list gives the species examined, and those indicated by a query are atypical for the subfamily. Though they all have the closed form of the ejaculatory sac, many of them show great differences of structure, indicating that the subfamily is far from a homogeneous group. This subfamily contains about as many species as all of the other subfamilies combined. In order to limit this study reasonably, none of the more divergent examples is here illustrated or discussed. Therefore, the more usual types belonging to certain well known generic groups were selected. Detailed drawings of any one species were not undertaken, since the general form is relatively close to the Acridinae and Oedipodinae\* and at present it is difficult to decide what species or group should be taken as characteristic of the subfamily.

In comparing the species represented in Figs. 63-74, those of *Schistocerca*, *Calliptamus*, and *Catantops* differ markedly from *Melanoplus* and *Podisma*

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\* See full illustration of *Diasosteira carolina*, Figs. 75-80. Also cf. drawings of other Cyrtacanthacridinae by Snodgrass (1935, pp. 81-85).

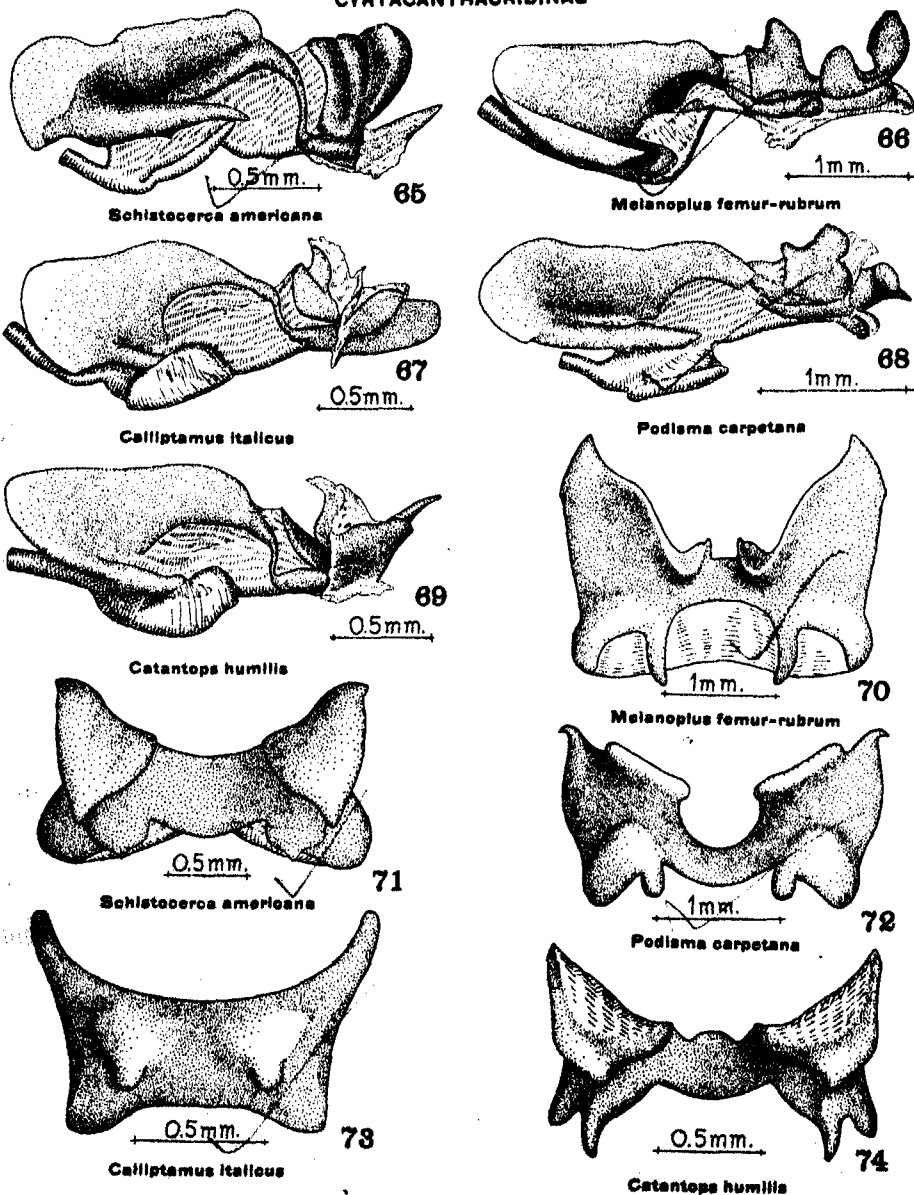


Figs. 60-62.—*Paulinia acuminata* (Pauliniinae). Fig. 60.—Lateral aspect of phallic sclerites and membranous structures, excepting basal fold and ventral infold, which are removed. Fig. 61.—Dorsal aspect of same. Fig. 62.—Epiphallus. Figs. 63-64.—*Eyprepocnemis shirakii* (Cyrtacanthacridinae). Fig. 63.—Lateral aspect of endophallic sclerites and membranous structures. Fig. 64.—Epiphallus.

in having a thin sigmoid flexure between the aedeagus and the endophallic plates. The last two genera have instead a constricted point of articulation between the endophallic plates and the aedeagus, and the aedeagus is highly modified. Whether these differences are of any real significance will have to await further study. The species *Eyprepocnemis shirakii*, Figs. 63, 64, is also distinctive in form and represents another group. Noteworthy is the form of the ancorae of the epiphallus, Fig. 64. These structures resemble those of the Oedipodinae and the Acridinae in that they are divided



## CYRTACANTHACRIDINAE



Cyrtacanthacridinae. Figs. 65-69.—Lateral aspect of endophallic sclerites and membranous structures. Figs. 70-74.—Epiphalli.

from the main body of the epiphallus by a membrane to form separate sclerites rather than being a continuous, sclerotized part of the epiphallus like most other Cyrtacanthacridinae. In other respects, however, *Eyprepocnemis* shows little similarity with the other two subfamilies.

#### Subfamilies OEDIPODINAE and ACRIDINAE

##### *Dissosteira carolina* (Linnaeus)

Figs. 75-80.

Since no outstanding phallic differences distinguish these two subfamilies, they are treated together. *D. carolina* (Oedipodinae) is fully illustrated for comparison with the excellent descriptions and drawings of Snodgrass (1935, p. 65). Because this present study omits any consideration of the musculature, indication of this feature is lacking in my drawings, whereas Snodgrass has well shown the muscles. In other respects, the drawings agree closely except for a few minor details. Snodgrass did not show the ventral infold (V-inf), Fig. 78, nor the sclerotized direct connection between the dorsal valves (D-v) and the median part of the zygoma (Zyg) of the cingulum, called the arch of the dorsal valves (A-d-v). The ventral infold is easily overlooked in these subfamilies, because it is very much reduced in size. The above mentioned arch of the dorsal valves is characteristic of these and related subfamilies.

The more outstanding features of these two subfamilies are the following: The ejaculatory sac (Ej-s) is closed and relatively small. There is a thin, sigmoid flexure (fix), Fig. 77, connecting the endophallic plates (Enph-pl) and the proximal end of the ventral aedeagal valves (V-v). There are two pair of aedeagal valves and an arch of the dorsal valves (A-d-v), as mentioned above. There is a well developed ventral lobe (V-lb), Figs. 75, 78, which is partly sclerotized on the outer side. The rami (Rm), Fig. 79, of the cingulum form a broad collar around the base of the aedeagus. The apodemes (Apd) of the cingulum are relatively heavy, rod-like processes. The ventral infold (V-inf), Fig. 78, is relatively small or much reduced. The epiphallus, Fig. 80, has a characteristic form, especially the ancorae (Anc) which, though closely connected to the lateral plates (L-pl) by membrane, are separate sclerites.

#### Species examined

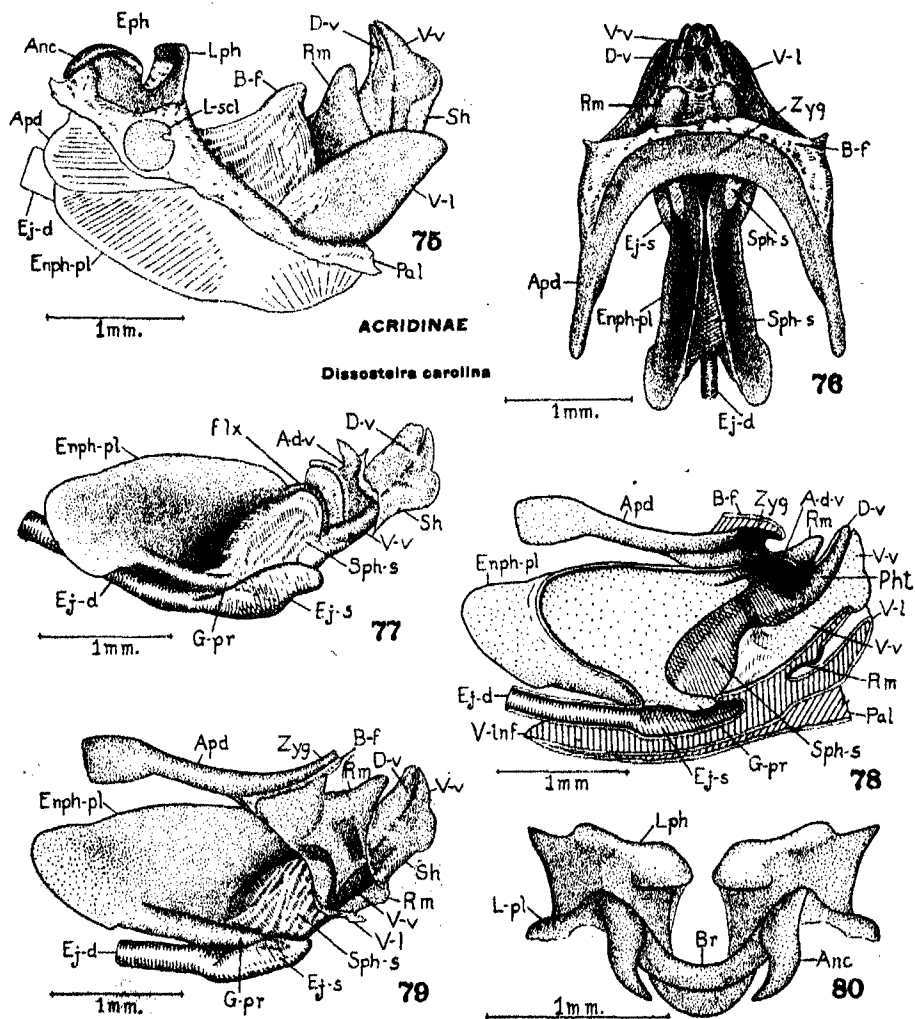
##### OEDIPODINAE

*Conipoda aldabrae* Saussure.

*Dissosteira carolina* (Linnaeus), Figs. 75-80.

*Egnathus apicalis* (Stål).

*Encoptolophus sordidus* (Burmeister).



*Dissosteira carolina* (Oedipodinae). Fig. 75.—Lateral aspect of phallus. Fig. 76.—Dorsal aspect of phallic sclerites and membranous structures, excepting basal fold and ventral infold, which are removed. Fig. 77.—Lateral aspect of endophallic sclerites and membranous structures. Fig. 78.—Sagittal section of phallus, showing sclerites and membranous structures. Fig. 79.—Lateral aspect of phallic sclerites and membranous structures, excepting most of basal fold and ventral infold, which are removed. (cf. Fig. 76). Fig. 80.—Epiphallus.

*Leprus elephas* Saussure.

*Oedaleus decorus* (Germar).

*Oedipoda coerulea* (Linnaeus), Figs. 84, 88.

*Pardalophora apiculata* (Harris).

#### ACRIDINAE

*Acrida turrita* Linnaeus, Figs. 85, 90.

*Boettettia argentatus* Bruner.

*Dichromorpha viridis* (Scudder), Figs. 81, 87.

*Machaerocera mexicana* Saussure.

*Paracinema tricolor* (Thunberg).

*Peruvia nigromarginata* Scudder.

*Stenobothrus grammicus* Cazurro, Figs. 83, 89.

Though some differences in proportion and details of the phallic structure are evident among the above list of species, as indicated in the drawings, they are fundamentally alike. The reader is also referred to the illustrations of four other species of those two subfamilies by Snodgrass (1935, pp. 73-78).

#### TABULATION OF STRUCTURAL DIFFERENCES OF THE SUBFAMILIES

The following tabulation shows the more important or characteristic features of the various subfamilies of the Acrididae. The features used are those that resulted from this present investigation together with other morphological structures that seemed significant. Of particular importance are the observations of Slifer (1939, 1940) concerning the form of the spermatheca in the female, and earlier work by the same author and R. L. King (1936) on the glandular pouches of the female. I am greatly indebted to Dr. C. E. McClung and Dr. Edwin R. Helwig for much unpublished data concerning chromosome numbers. The geographical distribution of the subfamilies is included as of particular interest.

##### I.—Chasmosacci Group of subfamilies

Open ejaculatory form of phallus. (For features associated with this and the closed ejaculatory sac form of phallus, mentioned below, refer to Generalized Description of Phallus.)

19 chromosomes (male diploid).

\*Follicles of testis radiate from vas deferens.

\*Diverticulum of spermatheca recurved.

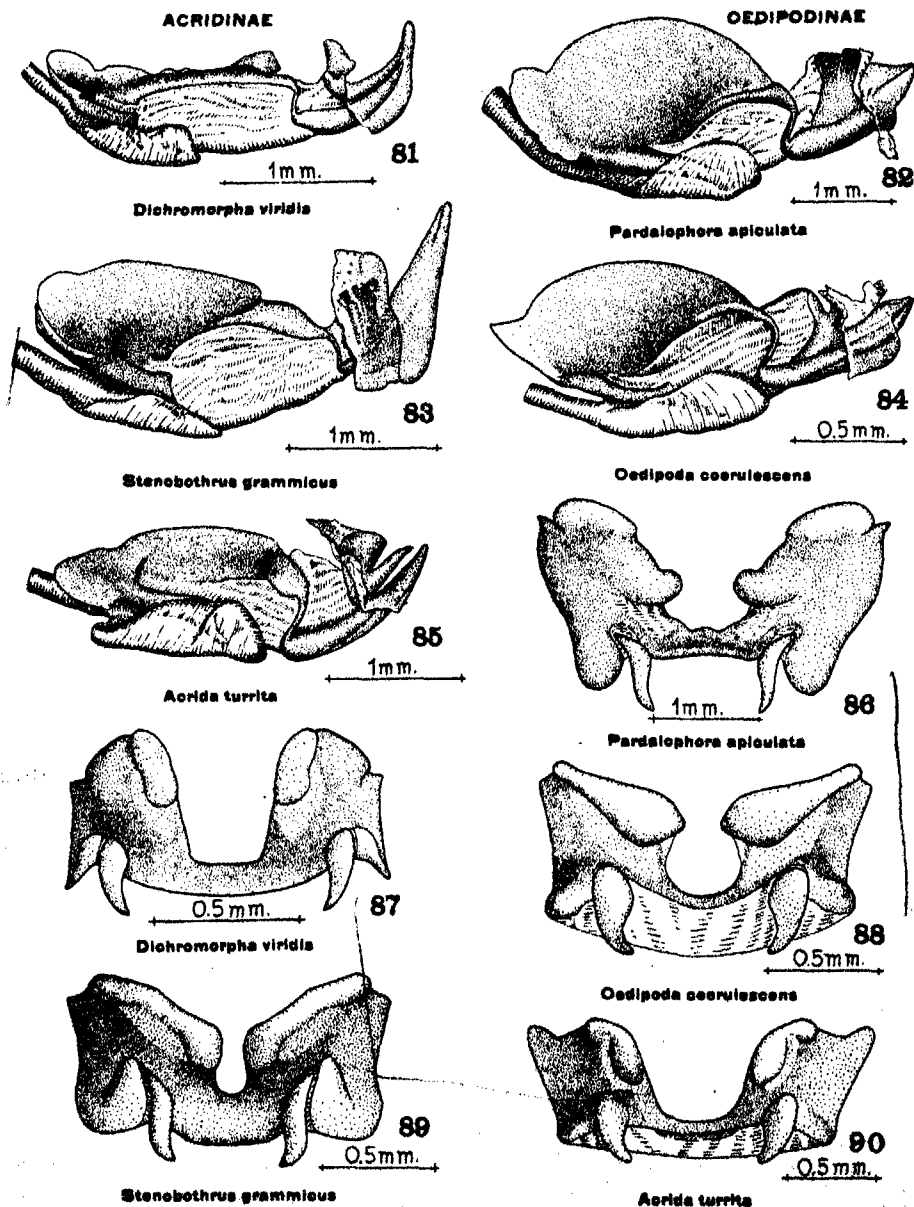
\*Lacks glandular pouches in the female.

\*No characteristic apical diverticulum of spermatheca.

\*Distal outer spine usually present on hind tibia.

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\* Asterisk indicates that the feature is not entirely limited to the group in question.



Acridinae and Oedipodinae. Figs. 81, 83, 85.—Lateral aspect of endophallic sclerites and membranous structures of Acridinae. Figs. 82, 84.—Lateral aspect of endophallic sclerites and membranous structures of Oedipodinae. Figs. 86, 88.—Epiphalli of Oedipodinae. Figs. 87, 89, 90.—Epiphalli of Acridinae.

**A.—Pyrgomorphae**

Simple rod-like pair of aedeagal valves that are continuous and non-articulating with the endophallic plates.

\*Cingulum connected to aedeagal valves only by membrane.

Distinctive form of epiphallus (see figures).

Distinctive form of fastigium of head capsule.

World wide, chiefly tropical in distribution.

**B.—Pamphaginae, Batrachotetrigeninae, and Thrinicinae**

Single pair of aedeagal valves which have a point of articulation with the distinctive shaped endophallic plates.

Rami of cingulum closely attached to aedeagal valves.

Epiphallus large and plate-like with two longitudinal, lateral rows of spines.

Old World, chiefly tropical in distribution.

**II.—Cryptosacci Group of subfamilies**

Closed ejaculatory sac form of phallus.

23 chromosomes (male diploid) with very few exceptions.

**C.—Ommexechinae**

Ejaculatory sac very large.

Aedeagal sclerites (hardly to be called valves) and endophallic plates continuous and non-articulating.

Equivalent of spermatophore sac doubtful or aberrant.

Cingulum obsolete.

Spermatheca distinctive (see Slifer 1940, plate I).

\*Glandular pouches of female present.

\*Follicles of testis radiate from vas deferens.

\*Distal outer spine of hind tibia absent.

South American in distribution.

**D.—Subfamilies of Cryptosacci other than the Ommexechinae**

Two pair of aedeagal valves which articulate or flex with the posterior end of the endophallic plates.

**1.—Romaleinae**

\*Arch of aedeagal valves absent.

Aedeagal valves relatively short and may be moved independently of each other.

\*Apodemes of cingulum relatively broad, plate-like, never heavy thick rods.

\*Ventral infold relatively large.

\*Follicles of testis radiate from vas deferens.

\*Diverticulum of spermatheca recurved.

\*Apical diverticulum usually absent or very small.

\*Glandular pouches of female usually present.

\*Distal outer spine of hind tibia present.

New World, chiefly Neotropical in distribution.

2.—Subfamilies treated below

Arch of dorsal aedeagal valves present and closely connected with zygoma of cingulum.

The two pair of aedeagal valves closely connected together by membrane of the phallotreme.

Apodemes of cingulum rod-like in form.

Ventral infold much reduced in size.

\*Follicles of testis lie parallel to each other and open into vas deferens near cephalic end of testis.

Diverticulum not recurved.

Apical and preapical diverticula present.

Distal outer spine of hind tibia absent except for a few small groups.

a.—Pauliniinae

Endophallic plates flare out laterad so that they lie chiefly in the horizontal plane and their gonopore processes are distinctive in form.

Arch of aedeagal valves unusually large and heavily developed.

\*Ventral aedeagal valves have point of articulation with endophallic plates.

Cingulum relatively small and reduced with very thin rod-like apodemes.

\*Glandular pouches of female vestigial or absent.

\*Outer distal spine of hind tibia absent.

South American (semi-aquatic) in distribution.

b.—Cyrtacanthacridinae

(A very diverse and perhaps polyphyletic group. For general features refer above under 2.)

\*Ventral aedeagal valves may have a point of articulation with the endophallic plates or may be connected by a thin sigmoid flexure.

\*Ventral lobe may be present or absent.

\*Ancorae of epiphallus (excepting *Eyprepocnemis*, see Fig. 64) not a separate sclerite.

Contains a few groups that have the outer distal spine of hind tibia.

World wide in distribution.

c.—Oedipodinae and Acridinae

\*Aedeagus simple in form.

\*Ventral aedeagal valves connected to endophallic plates by a thin sigmoid flexure.

- \*Ancorae of epiphallus developed into separate sclerites.
- \*Ventral lobe present.
- \*Glandular pouches of female absent.
- \*Outer distal spine of hind tibia absent.
- World wide in distribution.

#### DISCUSSION OF PHYLOGENETIC EVIDENCE

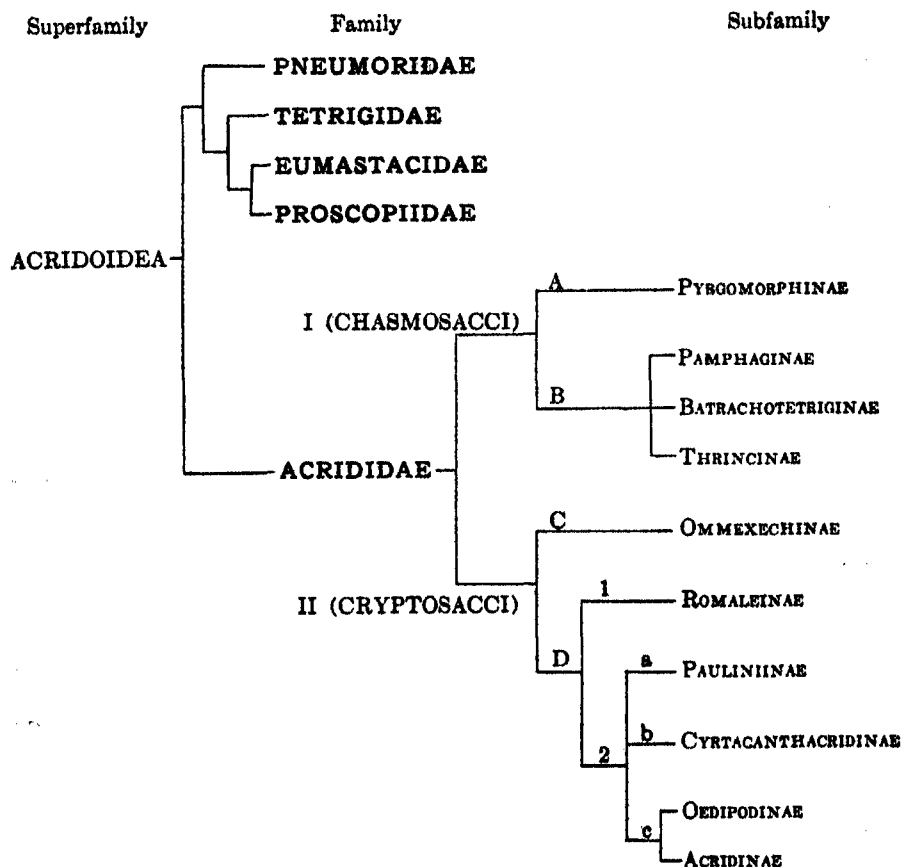
Today it is generally recognized that we must use all the morphological, physiological, embryological, and paleontological evidence that is available for sound phylogenetic studies. Yet, it is only very recently that other than external features have been used for the classification of the larger groups within the Acrididae. This may be explained by the preoccupation of systematists in the very necessary work of describing the many newly discovered species, even yet far from completed in the Orthoptera. Then again, those workers who have made comparative studies of the internal anatomy have chiefly concerned themselves with the larger categories of the Orthoptera, i. e., families to suborders.

Before discussing the features used as phylogenetic evidence, I wish to point out two well-known but very frequent sources of error in interpreting differences or similarities of structure. Similarity of form induced by similar environments found in animals of different ancestry is of common occurrence, but often difficult to detect. Such a case is that of *Tytthotyle maculata* of southwestern United States and *Eremocharis insignis* of North Africa, both from desert areas. Their external appearance in all details is so very similar that, up to the present, they have been placed in the subfamily Batrachotetriginæ. On the basis of their phallic structures (cf. Figs. 24 and 56) and other important features, *Tytthotyle* belongs to a quite different subfamily. This example suggests how we must use with caution the external features as indicators for such relationships, especially those easily modified by the environment.

The second source of error is the grouping together of animals which have a certain feature reduced or absent altogether. An obvious example of this is the reduction or loss of the wings and tegmina. There are many cases where in a group of even closely related species some will have functional wings and others will have them much reduced or totally absent. The point is that the loss or suppression of a structure is a relatively frequent and simple occurrence in contrast to the development of a new type or form of structure. Thus, the presence of a structure may be quite significant, but its absence should be treated as entirely negative, since we cannot determine whether it is a secondary loss or had never been present in the phylogeny of the animal, or, again, whether the loss has occurred independently in other animals. Examples, which are pertinent to the present study, are discussed below.



## PHYLOGENETIC TABLE OF THE ACRIDOIDEA



## EXPLANATION OF TABLE

The letters or numbers of the subfamily branches correspond to the sections under the heading "Tabulation of Structural Differences etc." presented above. The indicated relationships of the five families of the Acridoidea are very tentative, as detailed studies have not been carried out on all of these families. The superfamily Acridoidea together with the superfamily Grylloidea are considered to comprise the suborder Saltatoria.

The external features that have been most frequently used for the separation of the subfamilies are the form of the fastigium or dorso-cephalic part of the head, the venation of the tegmina, the presence or absence of the prosternal tubercle, and of the outer distal spine of the hind tibiae. The combined differences in these features have been used with considerable success to distinguish most of the subfamilies, but unfortunately they are of no great value in showing relative relationships. The presence of the prosternal tubercle or spine has been used to distinguish the Cyrtacanthacridinae, but there is some evidence to show that this structure is developed or induced by a bush-dwelling habitat. For example, the tubercle is present in *Goniatron planum* Bruner of the subfamily Oedipodinae, which is found in desert brush. The Oedipodinae of course characteristically lack this tubercle. The outer distal spine of the hind tibiae appears not to be influenced by any particular type of environment. In as much as it is present in what are considered the more primitive subfamilies, its absence in other subfamilies may be accounted for by the loss of the structure rather than it never having been present in the phylogeny of the group. According to the present classification, its loss has occurred independently in several different lines of evolutionary development. For example, it is present in the Pyrgomorphinae (with few exceptions), Pamphaginae and related subfamilies, and the Romaleinae. It is absent in the Ommexechinae, Oedipodinae, and Acridinae. There are several groups of Cyrtacanthacridinae in which it is present. From this and the phylogenetic chart, the Ommexechinae and the Acridinae, almost certainly, each separately lost the distal spine after they diverged from a common ancestor. The fastigium is perhaps of greater value for the diagnosis of genera, but all the subfamilies have a characteristic form or pattern with the exception of the Cyrtacanthacridinae. The relatively simple form of tegminal venation in the Pyrgomorphinae, as compared to the Acridinae, suggests that this feature may contribute valuable phylogenetic evidence, but it has been insufficiently studied thus far.

Concerning the internal anatomy, the digestive system has been described for a number of species, but studies are greatly needed on examples from the Pyrgomorphinae, Pamphaginae, and Ommexechinae. The nervous system has likewise been studied, but emphasis has been on the larger subdivisions of the Orthoptera and related orders, e. g. Nesbitt (1941).

Concerning the female reproductive structures, Slifer and King (1936) have reported on the taxonomic value of the presence or absence of glandular pouches at the cephalic end of the female genital chamber. This has given valuable new evidence, but the absence of the pouches for any particular species must be treated as negative evidence only. For example, all the genera which they have examined in the subfamily Romaleinae have these

pouches except *Agriacris* and *Procolpia*, and yet, from other evidence, they undoubtedly belong to this subfamily. A very comprehensive comparative study has been made by Slifer (1939, 1940a, 1940b) on the female spermatheca. The differences here are more in the nature of contrasting form rather than the presence or absence of a structure and this evidence has been of great value to my own conclusions. Incidentally, Slifer (1940b, p. 213) presented a tentative arrangement of the subfamilies, but unfortunately used the presence or absence of the glandular pouches as characters for her first two major divisions and then the secondary divisions were according to the form of the spermatheca. This would make the Acridinae more nearly related to the Pyrgomorphinae than to the Cyrtacanthacridinae. From much other evidence, there is little doubt that this is erroneous. Had the form of the spermatheca been used for the primary divisions and the presence or absence of these pouches for the secondary ones, a classification very similar to the one presented here would have been reached.

I am indebted to Dr. E. R. Helwig for allowing me to examine fixed testes to ascertain their gross morphological structure. Differences of structure between certain of the subfamilies have been evident for some time, and from this preliminary examination, the follicles were found to extend the length of the testis and open into the vas deferens near the cephalic end in the Acridinae, Oedipodinae, Cyrtacanthacridinae, and Pauliniinae. In the remaining subfamilies, the follicles are relatively shorter and enter (or radiate from) the vas deferens along the whole median length of the testis. Further comparative studies of this feature should prove fruitful.

As early as 1907, McClung (1908) suggested the possible value of the chromosome complex to taxonomy, from observations made on the Acrididae. Though much still remains to be done in this field, of particular importance is the observation that the Chasmosacci have a chromosome number of 19 (male diploid) and the Cryptosacci with few exceptions have 23.

Comparative studies of the phallic structures have proved to be of outstanding value as evidence for not only the diagnosis of the subfamilies but also for their relationships. No indication has been found that the form of the phallus becomes in any way modified for a particular kind of environment. With this lack of environmental influence, it is very unlikely that any particular form of structure would develop more than once during the course of evolution. Again, the differences of structure are for the most part contrasting forms rather than the presence or absence of a given feature. The comparative study of the phallus has made it possible to trace the development of certain structures among the various subfamilies and hence to obtain evidence toward the evolution of the group.

From physiology and paleontology, there is no phylogenetic evidence at the present time. Else (1934) described the embryology of the male repro-

ductive structures in *Melanoplus differentialis*, but unfortunately gave little detailed description of the transition between the relatively simple, early post-embryonic form and the complex adult form, so that the primitive form of the various elements of the phallus is not apparent. More recently Quadri (1940) has presented a comparative developmental study of the larger orthopteroid groups. Here also, the Acrididae are insufficiently treated to be of value to the present study. The very meager evidence from the other related families of the superfamily Acridoidea is also a handicap. Though the phallic structures of the Tetrigidae have been well described, the other three families are relatively unknown in this respect.

#### PHYLOGENY OF THE SUBFAMILIES

Assuming that the objective of a comparative morphological study is to discover the developmental history of the structure concerned and indirectly that of the group of animals, the major problem must be to determine the primitive or ancestral form of that structure. Evidence indicates that the open ejaculatory sac form of phallus of the Chasmosacci represents the more primitive one as compared with the closed ejaculatory sac form of the Cryptosacci. The following observations suggest this conclusion: There is but one pair of aedeagal valves with no indication of a previous second pair. The cingulum is formed by little more than simple, broad sclerotization of part of the outer covering or ectophallic membrane, including of course the dorsal invagination of this membrane to form the apodemes and zygoma. The apodemes are broad thin plates, whereas in most of the Cryptosacci they have become narrow, rod-like structures. There is certainly no indication that this plate-like form has developed from the rod-like form, but rather that the opposite has occurred. There is no sclerotized, median connection between the zygoma of the cingulum and the base of the aedeagal valves. The ventral infold is very large and sometimes even sclerotized, whereas in most of the Cryptosacci, it is very much smaller and appears to be vestigial rather than primitive. Thus, the other group (Cryptosacci) tends to show either a more specialized development of these structures or, as in the latter case, a vestigial remnant.

This open ejaculatory sac form of phallus of the Chasmosacci is compared with the general plan occurring in the Grylloidea (crickets, katydids, etc.) with considerable hesitation. However, there is at least a very suggestive resemblance between this large, open "ventral cavity" to which the ejaculatory duct leads in *Gryllus assimilis*<sup>5</sup> and the large, open ejaculatory sac of the Chasmosacci. Then again, the open "dorsal cavity" with the accompanying sclerites may be comparable to the spermatophore sac, phallotreme, and associated sclerites. This suggestive similarity may be

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<sup>5</sup> See Snodgrass, 1937, p. 79.

entirely fortuitous, but will certainly bear further consideration. Unfortunately there is no information concerning the functioning of the Chasmosacci form of phallus. In the Grylloidea, however, the spermatophore is known to be quickly attached to the outside of the female genital chamber and transfer of the sperm to the spermatheca occurs after copulation. In the Cryptosacci, copulation is a matter of hours and the spermatophore remains in the spermatophore sac of the male during transfer of the sperm to the spermatheca.<sup>6</sup> On the basis of structure alone, the Chasmosacci would appear to be a transitional stage between these two extreme methods of sperm transfer. Direct observation of this process will be awaited with considerable interest. Other features that are used for the diagnosis of the Chasmosacci give little phylogenetic evidence with the possible exception of the spermatheca. As noted by Slifer (1940a), these subfamilies show a simple development, in that they all have but a single diverticulum, though certain genera show a very specialized development of this part.

The two major divisions of the Chasmosacci have a number of important features in common, as may be seen from the table of structural differences, but at the same time they have striking diagnostic characters to separate them. The pamphagine association of subfamilies are a specialized development from the pyrgomorphs chiefly on the basis of their phallic structures. In contrast to the simple endophallic sclerites of the pyrgomorphs there is an articulation between the endophallic plates and the aedeagal valves, which is associated with other distinctive features. This form of articulation is undoubtedly a separate line of development and is in no way related to the form of articulation found in some Cyrtacanthacridinae and others. The form of the epiphallus is a radical departure from the other subfamilies. The geographical distribution of the pamphagines further suggests that they are a more recent development, since they are limited to the Old World in contrast to the worldwide distribution of the pyrgomorphs. The three subfamilies composing the pamphagines are certainly very closely related to each other with no evident feature of significance to distinguish them. Future study may show that they are best considered as one subfamily.

Of the Cryptosacci, the Ommexechinae is the most divergent subfamily. Of particular interest is the very large ejaculatory sac, the peculiar aedeagal valves with a large associated pouch, the rod-like endophallic plates, and the almost obsolete cingulum of the phallus. Noteworthy is the very distinctive spermatheca, as shown by Slifer (1940b). The form of the testes is closely similar to that of the Chasmosacci, which would indicate that this form is the more primitive and has been retained since their common ancestry. The Ommexechinae is undoubtedly a member of the Cryptosacci,

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<sup>6</sup> See Kyl, 1938; Snodgrass, 1935, p. 71; Boldyrev, 1929; and others.

however, on the basis of the closed ejaculatory sac and the chromosome number of 23. This subfamily comprises but a few genera that are limited to South America and may be considered for the present as having become early differentiated from the *Cryptosacci* stock. Several South American genera of the subfamily *Cyrtacanthacridinae* have been examined, that have a very distinctive form, and with further study these may aid in our understanding of the *Ommexechinae*.

The subfamily *Romaleinae* has an unusual combination of features. It has similarities in a number of important respects to the more highly developed subfamilies of the *Cryptosacci*, such as a small ejaculatory sac, the form of the endophallic plates and the presence of two pairs of aedeagal valves, and yet it has retained many primitive features, such as the plate-like form of the cingulum, the large ventral infold, the presence of the outer distal spine of the hind tibiae, the recurved diverticulum of the spermatheca, and the radiating follicles of the testis, so that it has many similarities to the *Chasmosacci*. Also the *Romaleinae* contains genera which have extreme differences of external form such as *Tropidacris* and *Phrynotettix*. The implication is that the subfamily is a relatively old group which has stemmed early from the main *Cryptosacci* stock and has become differentiated in certain respects, while retaining many primitive features. The *Ommexechinae* are thought to have branched off from the main stock earlier, however, because they show greater differentiation and less similarity to the other subfamilies of the group.

The subfamily *Pauliniinae* at present contains two South American genera peculiarly adapted to a semi-aquatic habitat. This subfamily belongs to the more highly developed subfamilies of the *Cryptosacci*. It is most closely related to the more usual forms encountered in the *Cyrtacanthacridinae*, and its distinctive features, at least as far as the phallic structures are concerned, are relatively simple modifications from this other subfamily. In addition to this, several genera have been examined, which are now placed in the *Cyrtacanthacridinae*, that almost certainly belong to the *Pauliniinae*. Before presenting the data concerning these other genera, I plan further studies to ascertain the limits of the group.

As has already been stated, the *Cyrtacanthacridinae* is a very heterogeneous assemblage. It includes several large, distinctive groups, as for example, the bird locusts (*Cyrtacanthacrides*) and the *Melanopli*. Whether these groups are sufficiently separable to warrant recognition as of subfamily status, will require further study. Aside from this problem, there are other genera which have no close affinity to any of these groups and violate the whole concept of the subfamily. Since, however, for the sake of convenience, all genera are necessarily placed within one subfamily or another, this subfamily may perhaps best be used as a "dumping ground"

for these aberrant genera, until we can associate them in a proper phylogenetic arrangement, rather than erect a number of subfamilies of uncertain limits and dubious relationship.

No satisfactory means of distinguishing the Acridinae from the Oedipodinae has been found. The two subfamilies, as a single group, form a relatively homogeneous division. Whether these should be ultimately reduced to one subfamily or even divided into more than two, is not possible to state from our present information. As may be seen from the presented "Tabulation of Structural Differences", little of fundamental importance distinguishes these two subfamilies from the Cyrtacanthacridinae. Almost certainly, their closest affinity is with this subfamily, but, at the same time, there are certain minor distinctive features that make them a well recognized group.

To summarize, the major relationships of the subfamilies of the Acrididae are indicated as far as our present data will allow. The two primary divisions of the family are the Chasmosacci and the Cryptosacci. The Pyrgomorphinae of the Chasmosacci have retained the most primitive condition with respect to the phallic structures. The pamphagine subfamilies of the Chasmosacci form a very distinctive and cohesive offshoot from the Pyrgomorphinae. The Ommexechinae belong to the Cryptosacci and has become very greatly differentiated. The new subfamily Romaleinae is more similar to the other members of the Cryptosacci, but has retained many very primitive features. The limits and relationships of the other subfamilies of the Cryptosacci (Pauliniinae, Cyrtacanthacridinae, Oedipodinae, and Acridinae) are more uncertain, though they are certainly more closely related to each other than to any of the above mentioned subfamilies. The position or relationship of certain genera within the subfamily Cyrtacanthacridinae is especially difficult, but the introduction or emphasis, at the present time, of these relatively minor exceptions or divergences, would obscure rather than clarify the general picture.

#### GENERA OF THE ROMALEINAE, NEW SUBFAMILY

FAMILY TYPE.—*Romalea* Serville, 1831, Ann. Sci. Nat., XXII, p. 280.

GENOTYPE.—*Romalea microptera* (Beauvais), 1805, by monotypy.

This subfamily name is founded on the genus *Romalea*, because it is without question the oldest name of the group and the genotype is well fixed, thus preventing any possible shuffling of names in the future. The following 36 genera are considered to belong to this subfamily. The species following each generic name has been seen by the author and 17 of these (indicated by an asterisk) have been dissected for examination of their phallic structures. Eight of these have also been figured, Figs. 40-59. Unstudied genera are considered sufficiently closely related to known genera

that no dissection was thought necessary. The two genera *Conometopus* Blanchard and *Aucacris* Hebard, which have been usually associated with this complex, were dissected and found not to be related. They are unusual in form and occur in Chile. They are best left within the *Cyrtacanthacridinae* for the present. For fundamental and distinguishing characters of the *Romaleinae* as well as its phylogenetic relationships refer to the forepart of this paper. This list of genera is arranged in a very tentative "natural" order, or at least those genera that are closely related are placed adjacent to each other in so far as possible.

- Batrachopus* † Blanchard, 1851. *B. viridis*\* (Blanchard), 1851  
*Aeolacris* Scudder, 1875. *A. bella* Rehn, 1909  
*Munatia* Stål, 1875. *M. biolleyi* Carl, 1919  
*Procolpia* Stål, 1873. *P. minor*\* Giglio-Tos, 1894  
*Prorhachis* Scudder, 1875. *P. granulosa* Scudder, 1875  
*Coryacris* Rehn, 1909. *C. angustipennis*\* (Bruner), 1900  
*Agriacris* Walker, 1870. *A. basalis*\* (Bruner), 1913  
*Elaeochlora* Stål, 1873. *E. viridicata*\* (Serville), 1839  
*Camposia* Bolivar, 1909. *C. octomaculata* (Bolivar), 1909  
*Brasilacris* Rehn, 1940. *B. gigas* Rehn, 1940  
*Cibotopteryx* Rehn, 1905. *C. variegata* Rehn, 1905  
*Alcamenes* Stål, 1878. *A. cristata* Bruner, 1906  
*Prionolopha* Stål, 1873. *P. serrata* (Linnaeus), 1758  
*Tytthotyle* Scudder, 1897. *T. maculata*\* (Bruner), 1890  
*Phrynotettix* Uhler, 1872. *P. tschivavensis*\* (Haldeman), 1852  
*Litoscirtus* Bruner, 1907. *L. insularis* Bruner, 1907  
*Dracotettix* Bruner, 1889. *D. m. monstrosus*\* Bruner, 1889  
*Xyleus* Gistel, 1848. *X. discoideus*\* (Burmeister), 1838  
*Helionotus* Rehn, 1909. *H. mirabilis* Rehn, 1909  
*Draconota* Pictet & Saussure, 1887. *D. mancus* Pictet & Saussure, 1887  
*Colpolopha* Stål, 1873. *C. obsoleta*\* (Serville), 1831  
*Taeniopoda* Stål, 1873. *T. auricornis*\* (Walker), 1870  
*Romalea* Serville, 1831. *R. microptera*\* (Beauvais), 1805  
*Brachystola* Scudder, 1876. *B. mexicana*\* Bruner, 1906  
*Callonotacris* Rehn, 1909. *C. lophophora* Rehn, 1909  
*Chromacris* Walker, 1870. *C. colorata*\* (Serville), 1838  
*Xestotrachelus* Bruner, 1913. *X. robusta* (Bruner), 1911  
*Chariacris* Walker, 1870. *C. miniacca* (Gerstaecker), 1899  
*Zoniopoda* Stål, 1873. *Z. iheringi*\* Pictet & Saussure, 1887

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\* Dr. Eleanor H. Slifer kindly examined a specimen of *Batrachopus viridis* and tells me (in litt.) that the spermatheca does not resemble *Romalea*. However, the form of the phallus agrees quite well with the general form of the subfamily, and I place it here pending further evidence.



- Prionacris* Stål, 1878. *P. erosa* Rehn, 1907  
*Aplatacris* Scudder, 1875. *A. colorata* Scudder, 1875  
*Lophacris* Scudder, 1869. *L. olfersii* (Burmeister), 1838  
*Titanacris* Scudder, 1869. *T. albipes* (De Geer), 1773  
*Eutropidacris* Hebard, 1922. *E. cristata*\* (Linnaeus), 1758  
*Tropidacris* Scudder, 1869. *T. dux* (Drury), 1773  
*Diponthus* Stål, 1860. *D. paraguayensis*\* Bruner, 1906

## SUPPLEMENT

*Terminology of the Phallic Structures and Associated Sclerites*

The phallic structures of certain genera of the Acrididae have been well described or treated by various authors, but considerable diversity appears in the names applied to them. This may be due to the fact that authors were more often interested in homologizing them with those in other groups of the Orthoptera. Since the Acrididae have a very highly specialized type of phallus, an attempt to draw too many homologies from the other members of the Orthoptera may be open to serious error, until at least we can be more certain of our ground. The terms that I have used in this paper have in most cases been selected from previous authors. In some instances, where the terms previously used were lengthy and cumbersome or confusing, new ones have been proposed. Following the discussion of each one treated below, I have given those which have been used by Snodgrass (1935), Walker (1922), and Chopard (1920) in so far as possible or as seemed necessary.

I wish to acknowledge with much appreciation the generous advice and suggestions given to me by Dr. R. E. Snodgrass and Dr. Ashley B. Gurney, both of the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, during my efforts to arrive at a satisfactory system of terminology.

**AEDEAGAL VALVES** (Aed-v), Figs. 5, 7, 19, 22: the paired lateral sclerites that develop chiefly from the endophallic membrane of the phallotreme duct and extend cephalad to the endophallic plates. The distal portion of these valves may be exposed processes at the end of the aedeagus, in which case their external, sclerotized surface may be considered as derived from the ectophallic membrane or part of the aedeagal sheath. In the Chasmosacci Group of subfamilies there are but one pair of aedeagal valves, but in the Cryptosacci Group there are usually a pair of dorsal and a pair of ventral valves (D-v and V-v). Refer to a discussion of these structures beyond.

**AEDEAGUS** (Aed), Figs. 1, 2: the distal part of the phallus which serves as the intromittent part of the organ. Aedeagus (Snodgrass); penis (Walker and Chopard).

**ANCORAE** <sup>a</sup> (Anc), Figs. 1, 43, 75, 80: a pair of hook-like structures of the epiphallus to be found at the anterior margin of this sclerite. Anterior processes (Snodgrass).

**APODEMES** (Apd), Figs. 4, 20, 41, 61, 76: a pair of latero-cephalic, sclerotized projections or processes of the cingulum formed by the invagination of the ectophallic membrane. Refer to discussion of cingulum beyond. Apodemes (Snodgrass); endapophyses (Walker); apophyses du pont (Chopard).

**ARCH OF DORSAL VALVES** (A-d-v), Figs. 60, 77, 78: a sclerotized median connection between the cephalic end of the dorsal aedeagal valves and the median part of the zygoma. This arch is a development from the aedeagal valves or endophallic membrane rather than from the zygoma of the cingulum or the ectophallic membrane. This structure is to be found or only evident in the subfamilies of the Cryptosacci, excepting the Ommexechinae and Romaleinae. Bridge of anterior phallotreme sclerites (Snodgrass).

**BASAL FOLD** (B-f), Figs. 1, 4, 5, 17, 40, 75: the part of the ectophallic membrane which extends from the zygoma of the cingulum back over the dorsum of the phallus to the sclerite called the epiphallus. This membrane frequently extends caudad some distance from the zygoma before turning back cephalad so that it forms a fold over the dorsal base of the aedeagus. Basal fold (Snodgrass).

**BRIDGE OF EPIPHALLUS** (Br), Figs. 43, 80: the median portion of the epiphallus which forms the connection between the two lateral plates. It is frequently in the form of a narrow, heavily sclerotized bar in the Acridinae and Oedipodinae, but is little if at all differentiated from the lateral plates in many of the other subfamilies. Bridge (Snodgrass).

**CERCI** (Cer), Fig. 21: prominent appendicular structures that arise between the latero-proximal angles of the supra-anal plate and the paraprocts. A small lobe, termed the cercal basipodite by Walker is present (not shown in Figure) on the dorsum of their base. Whether this is a true basipodite or even a coxopodite, is open to question.

**CINGULUM** <sup>b</sup> (Cng), Figs. 1, 2: primitively forms a thinly sclerotized capsule over the dorsum and sides of the phallus and is derived from the ectophallic membrane. This capsule-like condition is especially characteristic of the Pyrgomorphinae. The cephalic portion of this sclerite is formed by the deep invagination of the ectophallic membrane along a transverse line a short distance cephalad to the base of the aedeagus. This invagination extends back under the basal fold membrane to the cephalic end of the phallus. The caudal and median part of this invagination forms what is called the zygoma (Zyg). Among the more highly specialized groups, such as the Acridinae and Oedipodinae, the zygoma may become narrowed so that it forms a heavy transverse bar. The lateral portions of this invaginated part of the cingulum always extend more cephalad than the median portion. These latero-cephalic projections of the cingulum are called the apodemes (Apd). In the Chasmosacci these apodemes are little more than broad, plate-like projections, but in many of the Cryptosacci they are narrow and rod-like. From the latero-

<sup>a</sup> From ancora (anchor).

<sup>b</sup> From Latin meaning girth or girdle.

caudal margins of the zygoma two sclerotized arms or plates extend around the base of the aedeagus and may closely meet on the mid-ventral line. These caudal developments of the cingulum are called the rami (Rm) and are developed from the ectophallic membrane around the base of the aedeagus. The form and extent of development of the rami is very variable among the different subfamilies. The term cingulum is proposed here for the whole sclerite, which includes the apodemes, the zygoma, and the rami, since no general term has been used for this whole structure. Refer to the above-mentioned terms of the parts of the cingulum for the terminology of other authors.

**DORSAL VALVES OF AEDEAGUS (D-v)**, Figs. 40, 44, 60, 77: the pair of sclerites that develop from the phallotreme membrane and form part of the dorso-cephalic wall of the phallotreme duct and lie above the ventral valves. They extend from the end of the aedeagus or phallotreme back to the spermatophore sac. At their cephalic end they usually become fused together and develop a strongly sclerotized connection extending dorsad to the median part of the zygoma of the cingulum. This projection is called the arch of the aedeagal valves. The dorsal valves are only present in the Cryptosacci with the exception of the subfamily Om-mexechinae where they are not recognizable. Anterior (dorsal) lateral sclerites of phallotreme cleft, [including] the anterior (dorsal) apical processes of aedeagus (Snodgrass); [sclerites of] dorsal lobe (Walker).

**ECTOPHALLIC MEMBRANE**: the membrane which forms the outer covering of the phallus, including the aedeagus. It forms part of and is continuous with the membrane which lines the whole genital chamber. The cephalic part of the cingulum and the ventral infold are part or developed from this membrane.

**ECTOPHALLIC SCLERITES**: any phallic sclerite that is developed from the ectophallic membrane.

**ENDOPHALLIC MEMBRANE**: the membrane that lines the ducts and cavities of the phallus. It is ectodermal in origin and not fundamentally distinct from the ectophallic membrane.

**ENDOPHALLIC PLATES (Enph-pl)**, Figs. 5, 19, 38, 42, 60, 77: the cephalic portion of the pair of endophallic sclerites. The caudal portion of these endophallic sclerites are called the aedeagal valves. The endophallic plates characteristically flank part of the spermatophore sac and extend some distance cephalad to this cavity. A pair of processes are usually developed from this pair of plates which flank the gonopore and are called the gonopore processes (G-pr). The lateral movement of the endophallic plates in relation to each other, according to Snodgrass (1935, p. 69), controls the opening and closing of the gonopore by means of the movement of the gonopore processes. Endophallic plates (Snodgrass); base of parameres or endoparameres (Walker); valves supérieures (Chopard).

**ENDOPHALLIC SCLERITES**: the sclerites which are developed from the endophallic membrane. They form primarily one large, complex pair of sclerites and are developed chiefly from membrane of the phallotreme duct and spermatophore sac. For convenience they are subdivided into two principal parts, the aedeagal valves and the endophallic plates.

**EJACULATORY DUCT (Ej-d)**, Figs. 1, 5, 19, 37, 42, 60, 78: leads from the accessory glands and seminal vesicles, which lie just cephalad of the phallus, to the ejaculatory sac.

**EJACULATORY SAC (Ej-s)**, Figs. 1, 5, 19, 37, 42, 60, 78: situated at the terminus of the ejaculatory duct and below the spermatophore sac. It connects with this latter cavity through the gonopore. In the Chasmosacci the ejaculatory sac is relatively large and has at its caudal end a median cleft which opens to the exterior of the phallus. Among the Cryptosacci this cavity is usually much smaller and has no opening to the exterior.

**EPIPHALLUS (Eph)**, Figs. 1, 8, 17, 23, 39, 43, 62, 75, 80: distinctive sclerite, developed from the ectophallic membrane and lies in the cephalic end of the basal fold over the dorso-cephalic end of the phallus. For convenience in systematic work the following terms are used for its various parts: *ancorae*, *lophi*, lateral plates, bridge, and lateral sclerites. Refer to the descriptions of each of these terms individually. At the time of copulation this sclerite grasps the end of the 8th or ultimate sternum of the female and may also aid in depressing the supra-anal plate of the male. Epiphallus (Snodgrass); pseudosternite (Walker); epiphalle (Chopard).

**FURCULAE (Fur)**: the paired median processes on the caudal margin of the 10th tergum; may be absent, widely separated, partially fused along their median proximal margins, or completely merged so that they lose their paired identity. Apparently first used by Scudder<sup>10</sup> in the singular, because they are fused at the base in many species of *Melanoplus*, but actually their primitive and usual appearance is as a distinctive pair of lobes. Since their considerable taxonomic use makes reference to them as a single unit very awkward, a change in his meaning, so as to consider each process a furcula or the pair as furculae, seems desirable. Drawings of these structures do not happen to be given in this present paper, but have followed this terminology in previous taxonomic papers.

**GENITAL CHAMBER (G-ch)**, Figs. 1, 2, 19: the cavity which surrounds the outer or exposed surface of the phallus, when in its retracted position, and is enclosed by the pallium, paraprocts, and supra-anal plate.

**GNOPORE (G)**, Figs. 1, 2, 5: the short connection which leads from the ejaculatory sac to the spermatophore sac.

**GNOPORE PROCESSES (G-pr)**, Figs. 19, 40, 60, 77: the ventral processes of the endophallic plates that extend around the sides of the gonopore. Concerning their function, refer to the endophallic plates described above. These processes are poorly if at all developed in the Chasmosacci. Gonopore processes (Snodgrass).

**LATERAL LOBES (L-lb)**, Figs. 3, 17: characteristic only of the Chasmosacci and lie on either side at the proximal external portion of the phallus.

**LATERAL PLATES OF EPIPHALLUS (L-pl)**, Figs. 43, 80: the main lateral portions of the epiphallus from which the *ancorae* (Anc) and *lophi* (Lph) arise and are connected mesad by the bridge (Br). This term is only applied to the form of epiphallus as found in the Cryptosacci. Lateral lobes [in part] (Snodgrass).

**LATERAL SCLERITES OF EPIPHALLUS (L-scl)**, Fig. 75: A pair of flat, usually round sclerites that lie in the membrane on either side of the lateral plates of the epiphallus and serve for the insertion of a pair of muscles from the 9th segment called the retractors of the phallus by Snodgrass. The equivalent of these sclerites have not been identified in the Chasmosacci and are only characteristic, though not always present in the Cryptosacci.

<sup>10</sup> Scudder, Proc. U. S. Nat. Mus., 20: 3, 1897.

LOPHI<sup>11</sup> (Lph), Figs. 43, 75, 80: the large pair of processes that project more or less vertically from the lateral plates of the epiphallus. They are only characteristic of the Cryptosacci and serve as a grasping structure. Whether the grasping processes in the Chasmosacci, especially in the subfamily Pyrgomorphinae, are homologous to these structures is not clear. Posterior processes of epiphallus (Snodgrass); postcornua or processes of pseudosternite (Walker).

PALLIUM (Pal), Figs. 1, 19, 42, 75: the thick membrane which forms a fold over the posterior dorsum of the genital chamber and covers over the aedeagus. Its outer margin arises from the distal margin of the subgenital plate and connects internally with the ectophallic membrane at the mouth of the ventral infold. Pallium (Snodgrass and Walker); *capuchon inférieur* (Chopard).

PARAPROCTS (Ppt), Figs. 1, 19, 21: the pair of plates or folds that lie largely beneath the supra-anal plate and latero-ventrad of the anal orifice. According to Snodgrass, these and the supra-anal plate make up the 11th segment. Paraprocts (Snodgrass and Walker); *valves anales inférieures* (Chopard).

PHALLOTREME (Pht), Figs. 1, 5, 19, 78: strictly speaking the external opening of the phallus, but its meaning is here extended to include the short passageway or duct between the spermatophore sac and the external opening or phallotreme cleft. In the Cryptosacci the phallotreme cleft may extend a short way back from the end of the aedeagus along the mid-ventral line, but in the Chasmosacci this cleft extends all the way back to the gonopore, although it is normally closed by the close apposition of the aedeagal valves. Phallotreme (Snodgrass).

RAMI OF CINGULUM (Rm), Figs. 3, 60, 79: processes that extend from the latero-caudal margins of the zygoma (Zyg) ventrad around the base of the aedeagus. They are very variable in shape and degree of development. They may encircle the whole of the aedeagus and meet on the mid-ventral line, or they may project but a short distance from the zygoma. Then again they may be broad plates or simple rods. The sheath of the aedeagus arises from their caudal margin, and the ventral lobe, when present, from their cephalic ventral margin. Lateral plates in the proximal part of the dorsal lobe (Snodgrass); *rami* (Walker); *valves inférieures* (Chopard).

SHEATH OF AEDEAGUS (Sh), Figs. 60, 75: outer membranous covering of the aedeagus which arises from the caudal margin of the rami and zygoma of the cingulum and extends to the aedeagal valves or phallotreme cleft. In some cases, as in the Pamphaginae, the whole outer portion of the aedeagus is sclerotized so that what might be called the sheath is not distinguishable from the rami of the cingulum. Among certain groups of genera, as for example the Melanopli of the Cyrtacanthacridinae, the sheath becomes very complex and much folded. In such cases it is frequently of taxonomic value together with the apices of the aedeagal valves in distinguishing species or subspecies. [Outer membrane of] distal part of dorsal lobe of aedeagus (Snodgrass); [outer membrane of] dorsal and ventral lobes (Walker); *prépuce* (Chopard).

<sup>11</sup> From *ζύγιον* (crest).

**SPERMATOPHORE SAC (Sph-s)**, Figs. 1, 2, 5, 19, 42, 78: the phallic cavity which lies dorsad of the ejaculatory sac and is connected with the latter through the gonopore. The phallotreme leads from its caudal end out through the aedeagus.

**SUBGENITAL PLATE (Sgl-pl)**, Figs. 1, 2, 21: the ultimate sternite not including the 9th sternum. As observed by a number of authors, this sclerite in the 1st larval instar may be bilobed caudad and separated from the 9th sternum by a transverse suture and remains as a more or less distinct sclerite in the adult, with the exception of a few groups as in the Pamphaginae where it merges completely with the 9th sternum. It seems desirable to retain the term subgenital plate for this ultimate sternite and limited so as not to include the 9th sternum, since it has been used to such an extent in taxonomic literature. 9th sternal lobe (Snodgrass); coxite of 9th sternum (Walker); plaque sous-genitale [including 9th sternum] (Chopard).

**SUPRA-ANAL PLATE (Spl-pl)**, Figs. 1, 21: the ultimate dorsal plate of the abdomen which covers the anal orifice and part of the paraprocts and genital chamber. This and the paraprocts make up the 11th segment according to Snodgrass. Epiproct or supra-anal plate (Snodgrass); supra-anal plate (Walker); plaque suranale (Chopard).

**STERNUM (S)**: I follow Snodgrass (1931, p. 7) in using this term for a major segmental plate of the venter, whereas the term sternite is used for subdivisions or component elements of the sternum. For a major segmental plate of the dorsum I follow the use of tergum and tergite in the same manner.

**TERGUM (T)**: refer to sternum above.

**VENTRAL INFOLD (V-inf)**, Figs. 1, 2, 5, 19, 40, 78: a thin, usually membranous invagination of the ectophallic membrane at the base of the phallus and extending under most of the venter of the phallus. It is comparable to the invagination on the dorsum of the phallus which gives rise to the rami and zygoma of the cingulum. Its function appears to be only that of a sheath between muscles and with some muscle attachments. In the Chasmosacci it is most extensively developed and may be sclerotized on its dorsal side, whereas in the Cryptosacci it is never sclerotized and is much reduced in size so that it may be easily overlooked in dissections.

**VENTRAL LOBE (V-lb)**, Figs. 1, 75, 78: a large external fold that surrounds the ventral and lateral portions of the aedeagus. This feature is only present or at least developed among certain members of the Cryptosacci. Snodgrass (1935, p. 63) believes this part of the phallus to be homologous to what he calls the ventral lobe in the Tettigoniidae and Gryllidae. Ventral lobe (Snodgrass); subventral lobe (Walker); capuchon inférieur (Chopard).

**VENTRAL VALVES OF AEDEAGUS (V-v)**, Figs. 40, 42, 60, 77: the ventral pair of lateral sclerites that extend along the phallotreme duct back to the spermatophore sac where they connect with the endophallic plates. These phallotreme sclerites are only called ventral valves when there are a dorsal pair present, as among the Cryptosacci. Among the Chasmosacci, where there are but one pair of sclerites present, they are simply called aedeagal valves. Posterior (ventral) lateral sclerites of phallotreme cleft, [including] posterior (ventral) apical processes of aedeagus (Snodgrass); parameres, or their main processes, also ectoparameres (Walker);

ZYGOMA (Zyg), Figs. 1, 4, 20, 41, 78: the median transverse part of the cingulum which lies under the caudal part of the basal fold. It is largely developed from an invagination of the ectophallic membrane. The pair of apodemes of the cingulum extend cephalad from its lateral portions and the rami extend caudad or, in relation to the long axis of the phallotreme, ventrad from its latero-caudal margins. Zygoma (Snodgrass); arch of endopophyses (Walker); pont postérieur (Chopard).

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## THE GEORGE VANDERBILT OAHU SURVEY—THE FISHES

BY HENRY W. FOWLER

*Curator of Fishes, The Academy of Natural Sciences of Philadelphia*

The collection of fishes made in 1940 is of special value for its interesting representation of tide pool forms, having disclosed a number of novelties. Altogether 780 specimens were obtained representing 68 species, of which 5 are described and figured as new. Eight are with the indicated genotypes of as many new genera. From an interesting series of remoras taken from large game fishes and collected during Mr. Vanderbilt's fishing excursions, I am now able to determine correctly 2 interesting species heretofore not admitted in the Hawaiian ichthyofauna.

Again the Academy acknowledges an important addition to its department of ichthyology, no less a tribute to Mr. Vanderbilt's industry in its consummation than to his continued interest in the development of our study collection of fishes. Credit is due Mr. W. H. Cunningham who assisted in collecting many of the specimens.

Color notes were made from many of the freshly received specimens, as many remained brilliant for a long time. Some of these are given below when of apparent value. A few references, as the original citation and clues to the literature, are given for some of the species meriting special notice.

### DUSSUMIERIIDAE

*Stolephorus delicatulus* (Bennett)

Two, 56 or 57 mm., taken with light at night off Diamond Head, September 10. Back and above blue-black, and sides and below bright silvery white. Pietschmann 1938 names this "forma hawaiiensis" but without definition, diagnosis, description or figure.

### MURAENIDAE

*Gymnothorax meleagris* (Shaw)

One, 200 mm., Kaena Point, August 12. Dark blackish brown, with numerous obscure darker to blackish spots. Hind margin of caudal very narrowly white.

One, 248 mm., Waianae, September 1. Similarly dark and very obscure small pale spots, not nearly so contrasted as Baldwin's rather poor wash drawing published as *Gymnothorax laysanus* by Jordan and Evermann in 1905.



**POECILIIDAE (introduced)**

**Gambusia affinis** (Baird and Girard)

Two, 26 to 28 mm., Oahu, July.

**Mollinesia latipinna** Le Sueur

Fourteen, 34 to 60 mm., Coca Head, May 6; seven, 27 to 65 mm., Nanakuli, May 18; two, 54 to 65 mm., July.

**PLEURONECTIDAE**

**Bothus pantherinus** (Rüppell)

One, 43 mm., Waianae, April 30. General color ochraceous-pink, with pale spots and darker shadings. Many dark to blackish round spots.

**HOLOCENTRIDAE**

**Holocentrus lacteo-guttatus** Cuvier

General color dark rose-purple, with longitudinal or horizontal rose-red bands all much narrower than alternating dark rose-purple bands which ensue and following in junctures of scales. Head with rose-purple scales, bones and sutures more scarlet. Iris dark rose-scarlet. Variably whole of sides and below with underlaid dark brown spots and specks, producing swarthy appearance especially on head and trunk below in some specimens. Others with muzzle dark blackish brown. First dorsal largely orange-vermilion, with a dark or blackish longitudinal median band. Sometimes ends of each membrane and basal region shaded with black. Rayed vertical fins orange-red, membranes paler, with front of anal on long third spine dark or brownish gray. Paired fins orange.

Five, 80 to 89 mm., tide pools near Blow Hole, April 6.

Eight, 70 to 95 mm., Coca Head, May 6; three, Waianae, June 17; one, 82 mm., Makapu (Honolulu market), mid-June; two, 98 to 102 mm., Mogua Reef, July 12; one, 102 mm., Waianae, July 12; three, 63 to 67 mm., Kaena Point, August 12; two, 60 to 68 mm., Waianae, September 1.

**Holocentrus microstomus** Günther

Three, 103 to 118 mm., Waianae, June 17.

**SYNGNATHIDAE**

**Hippocampus kuda** Bleeker

One, 65 mm. (snout broken), from stomach of skipjack and tuna taken off Kaena Point, June 20.

**AULOSTOMIDAE**

**Aulostomus chinensis** (Linnaeus)

One, 228 mm., Mogua Reef, July 12. Dark brown with narrow pale transverse bands, also several pale spots in each brown area.

**FISTULARIIDAE****Fistularia petimba** Lacépède

One, 250 mm., Waianae; four, 225 to 290 mm., Waianae, July 17; one, 175 mm., with light at night off Diamond Head, September 10.

**ATHERINIDAE****THORACATHERINA** new genus

Type.—*Atherina insularum* Jordan and Evermann.

Body elongately fusiform, well compressed, with flattened sides approximating more below. Head moderate, broadly depressed above, sides flattened. Snout broad, end level with middle of eye. Eye large, superolateral, subequal with snout. Maxillary extends below front of eye. Mouth large, well inclined, gape straight, lower jaw little included in closed upper jaw. Teeth finely villiform, in somewhat broad bands in jaws, on vomer and palatines, also exposed along front edges of closed jaws. Lips narrow. Interorbital broad, flat. Gill openings lateral. Gill rakers lanceolate, lower 16 or 17. Scales very narrowly imbricated, 2 median longitudinal series on body especially deep or wide, and at middle of each hind edge of exposure close-set series of 2 to 4 small irregular apical denticles so that they are prickly to touch. Infrapectoral scale greatly enlarged and 2 large scales cover pectoral base. Opercle covered by 2 very large scales. Caudal base scaly. First dorsal slightly postmedian in body, small. Second dorsal larger, shorter than head, elevated in front. Anal nearly as long as head, highest in front. Caudal forked. Pectoral high, broad. Ventrals shorter than pectoral.

Differs from the American genus *Atherinomorus* chiefly in its naked dorsals, anal and pectorals, the scale exposures along the sides more narrowly imbricated and deeper, in proportions as smaller eye and larger snout and the body more elongated. The lateral silvery band is also broader. *Atherinomorus*<sup>1</sup> however agrees in the low mandibular rami and the greatly enlarged infra-pectoral scale. *Hepsetia* Bonaparte differs from *Atherinomorus* chiefly in its small infra-pectoral scales.

( $\theta\omega\mu\alpha\xi$  thorax + *Atherina*; with reference to the large infrapectoral scale.)

*Thoracatherina insularum* (Jordan and Evermann)

Figure 1 (Nanikuli).

*Atherina insularum* Jordan and Evermann, Bull. U. S. Fish Comm., vol. 22, 1902 (1903), p. 170 (type locality, Honolulu; Lahaina; Kailua; Hilo); vol. 23, pt. 1, 1903 (1905), p. 138, fig. 47 (erroneous figure of type).—Fowler, Acad. Nat. Sci. Phila. Monographs, no. 2, 1938, p. 275 (reference); Proc. Amer. Phil. Soc., vol. 82, no. 5, 1940, p. 761 (Maui specimens).

*Hepsetia insularum* Fowler, Mem. Bishop Mus., vol. 10, 1928, p. 119 (Maui; type; Honolulu; Kailua; Hanalei R.; Waikiki; Koolau Bay; Laie Stream; Lisiansky); vol. 11, no. 1, 1931, p. 324 (Honolulu); vol. 11, no. 6, 1934, p. 398 (reference).

<sup>1</sup>The genotype *Atherina laticeps* Poey = *Atherinomorus stipes* (Müller and Troschel) examined, its head and trunk delineated, see figure 2 (Bimini, Bahamas, July 28, 1935).

Five, 96 to 111 mm., Nanakuli, May 18; four, 46 to 105 mm., Waianae, July 17; one, 47 mm., Kaena Point, August 12.

For comparison I have an example 50 mm. long from Honolulu, July 12, 1901, obtained by the United States Fish Commission and identified as *Atherina insularum* Jordan and Evermann. This specimen agrees in every way with the above materials and is further evidence of the imperfect and misleading figure (no. 47 drawn by W. S. Atkinson from the type and published by Jordan and Evermann as *Atherina insularum*). Not only is the squamation shown as erroneous but also 5 dorsal spines while the description gives 6.

#### MUGILIDAE

*Neomyxus chaptalii* (Eydoux and Souleyet)

Ten, 44 to 67 m., tide pools near the Blow Hole, April 5; one, 53 mm., Waianae, April 20; four, 49 to 53 mm., Nanakuli, May 18; two, 57 to 83 mm., Waianae, May 20; three, 48 to 54 mm., tide pools near the Blow Hole, June; five, 49 to 62 mm., off Oahu, July; three, 65 to 75 mm., Waianae, July 17; three, 47 to 61 mm., Kaena Point, August 12.

#### CARANGIDAE

*Gnathanodon speciosus* (Forskål)

One, 145 mm., Makepu (Honolulu market), mid-June. Fins all more or less yellowish also predorsal region and muzzle and paired fins somewhat buff. Transverse bands and lines dark gray. Iris silvery white.

#### DULEIDAE

*Dules sandvicensis* (Steindachner)

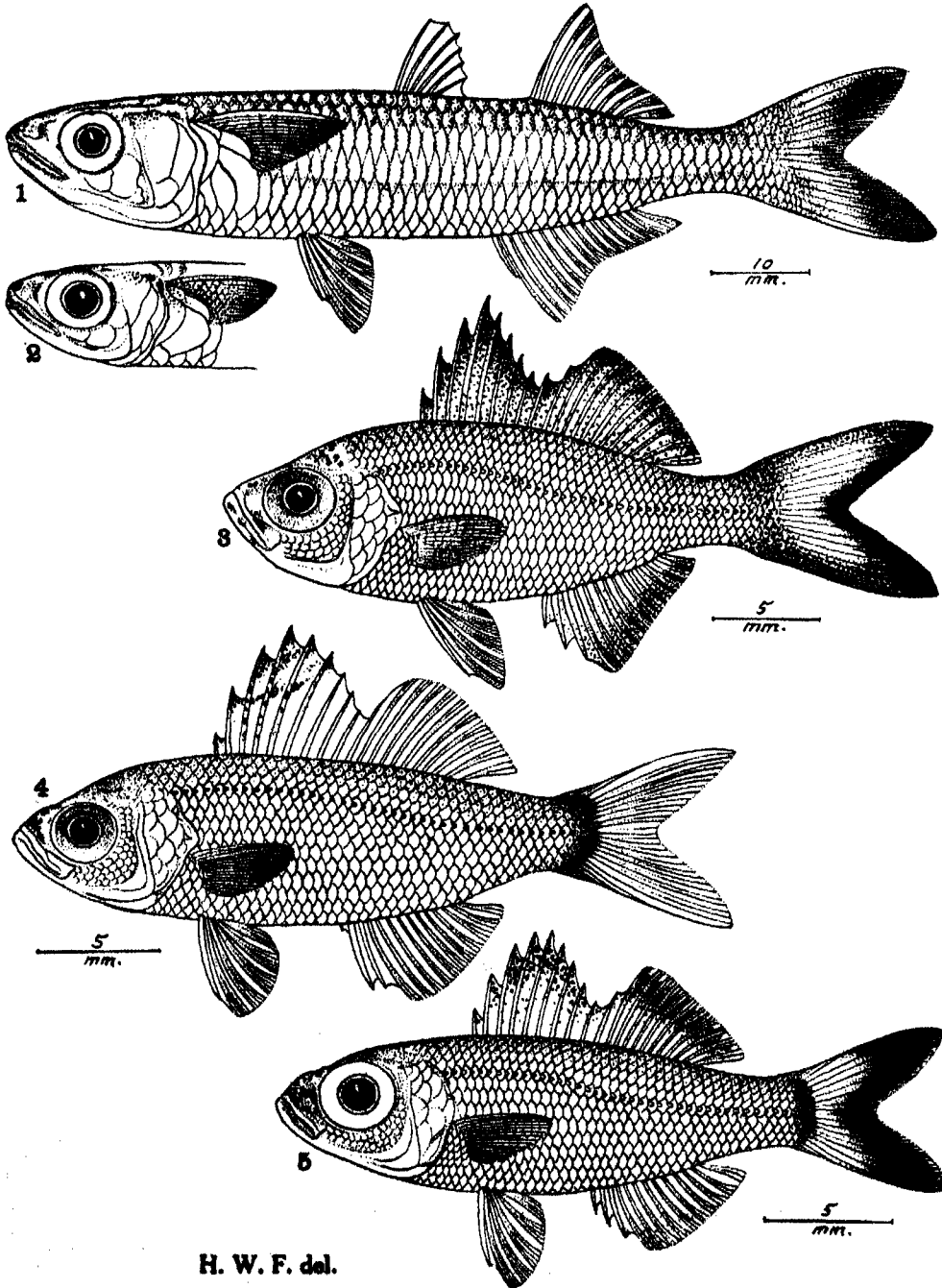
Figures 3 to 5 (off Oahu).

Five, 27 to 61 mm., tide pools near the Blow Hole, April 5; two, 53 to 80 mm., Waianae, April 20; eight, 50 to 82 mm., Honolulu harbor, May 6; one, 58 mm., Waianae, May 20; thirteen, 28 to 44 mm., Blow Hole, June; one, 53 mm., Waianae, June 17; thirty-four, 25 to 58 mm., off Oahu, July; four, 70 to 145 mm., Waianae, July 17; eighteen, 45 to 68 mm., Kaena Point, August 12.

#### APOGONIDAE

*Apogon fraenatus* Valenciennes

General color warm brown, more or less pinkish buff on under surfaces and especially under surface of tail. Many scales on back and sides show scale exposure pearly and borders of scales brown. Iris olive-gray. Diffuse dark lateral band around end of snout, through eye and along middle of side to caudal base above. Maxillary and mandible ruddy brown. First dorsal olive-green, with greenish black front border. Second dorsal with membranes basally and rays reddish, greater outer part of membranes olive shaded with dark gray and dark gray subbasal band across fin.



H. W. F. del.

FIG. 1.—*Thorneatherina insularum* (Jordan and Evermann). FIG. 2.—*Atherinomorus stipes* (Müller and Troschel). FIGS. 3 to 5.—*Dules sandvicensis* (Steindachner).

Anal reddish, with black subbasal band across fin. Caudal red, with broad black basal band and upper and lower edges of fin narrowly blackish, ends of lobes narrowly gray. Paired fins reddish, front of ventral with submarginal brown band.

Two, 41 to 69 mm., Mogua Reef, July 12; three, 61 to 87 mm., Waianae, September 1.

**Apogon erythrinus** Snyder

Color when fresh in alcohol bright orange-red generally, more intensified or orange-vermilion along bases of dorsals, on mandible, caudal basally and medially, on ventral and anal basally. Iris dark warm brown to gray-black. Brownish underlaid shades on cheek and opercles, also on top of head. Underlaid olive spots or dots on predorsal and about caudal base. Usually some blackish spots along front of both first and second dorsal bases.

One, 38 mm., Mogua Reef, July 12; two, 34 or 35 mm., Waianae, July 17; three, 43 to 49 mm., Waianae, September 1.

**Apogon brachygrammus** (Jenkins)

*Fowleria brachygrammus* Jenkins, Bull. U. S. Fish Comm., vol. 22, 1902 (1903), p. 448, fig. 20 (type locality, Honolulu).

*Amia brachygramma* Fowler, Mem. Bishop Mus., vol. 10, 1928, p. 162 (Pearl City; Honolulu; type; Hawaii); Acad. Nat. Sci. Phila. Monographs, no. 2, 1938, p. 280 (reference).

*Apogonichthys brachygrammus* Fowler, Mem. Bishop Mus., vol. 11, no. 6, 1934, p. 408 (reference).

General color when fresh in alcohol brown, edge of each scale narrowly and sharply dark brown. Muzzle and top of head drab brown. Iris gray, darker above. First dorsal dark brown, with pale or grayish arched band across fin just above middle and usually upper border much darker. Second dorsal olive-green, terminally pale to dark gray. Anal and caudal largely yellowish green, with dark brown median area on each lobe longitudinally in adult. Paired fins pale or grayish white, ventrals dark brown to gray-black over terminal portions in largest.

Four, 30 to 50 mm., Honolulu harbor, May 6; one, 39 mm., Nanakuli, May 18.

**KYPHOSIDAE**

**Kyphosus bigibbus** Lacépède

Color when fresh in alcohol largely with bright golden yellow longitudinal lines, following over each row of scales, especially below lateral line where in horizontal series.

One, 130 mm., Coca Head, May 6.

**MULLIDAE**

**Pseudupeneus porphyreus** Jenkins

Color in alcohol back warm brown to olive-brown, each scale with dark submarginal line. Dark olive streak on side of snout to eye, then back

toward front base of second dorsal, with large blue-black spot on second scale from eye. Iris rose, also cheek, lower side of head, chest, breast and belly, becoming light rose-purple on lower surface of tail. From opercle gray-white ill-defined band back, up along below lateral line above depressed pectoral. Pink spot on each side of back close below last dorsal ray. First dorsal rose-gray, pale orange basally and membranes olivaceous on outer portion. Second dorsal like first on front margin or border of fin crimson. Anal rose-vermilion in front, pink behind. Caudal orange, also pectoral. Ventral rose-vermilion, front and hind edges pale rose. Barbels golden.

One, 80 mm., Waianae, May 20.

#### **MALACANTHIDAE**

*Malacanthus hoedtii* (Bleeker)

One, 236 mm., Honolulu.

#### **CIRRHITIDAE**

*Cirrhitus pinnulatus* (Schneider)

One, 63 mm., Waianae; two, 62 to 114 mm., Waianae, May 20; one, 115 mm., Mogua Reef, July 12.

*Paracirrhites fasciatus* (Bennett)

Two, 88 to 101 mm., Mogua Reef, July 12. Tail and under surface of body pink to bright vermilion.

#### **CHAETODONTIDAE**

*Chaetodon lunula* (Lacépède)

General color in alcohol, dark olive-brown over most of median part of body, becoming more or less tinged with yellowish posteriorly and below. Snout and muzzle pale yellowish. Broad black band from near front of first dorsal down to include most of interorbital, leaving narrow front border of eye pale, and narrowing below on subopercle, but not meeting its fellow across breast. Posteriorly an equally broad gray band down from before front of first dorsal, including narrow edge of shoulder girdle behind gill opening, fading below into pale yellowish of chest and breast. This broad gray band delimits large black area following at front side of back. Broad black band transversely across front of caudal peduncle, with suffused golden-yellow band up to dorsal ocellus and down along anal base; posteriorly on caudal peduncle narrow white transverse band, then little broader buff one and finally black bar on caudal base, leaving caudal otherwise gray. First dorsal with broad golden-orange border, notched edges of membranes posteriorly becoming blackish and on second dorsal form black submargin next to narrow white margin. Large black ocellus on front of soft dorsal, ringed with bright golden-orange. Anal olivaceous, golden band next to narrow black submargin leaving margin narrowly white. Pectoral grayish, yellowish basally. Ventral golden-yellow, olivaceous basally.

One, 80 mm., in brackish pool, Oahu, May 6; five, 28 to 42 mm., Waianae, May 20, dorsals and front of anal more or less orange-vermilion; five, 25 to 30 mm., Blow Hole, June; one, 50 mm., Waianae, July 17; one, 59 mm., Kaena Point, August 12.

**Chaetodon miliaris** Quoy and Gaimard

One, 33 mm., Waianae, April 20; one, 38 mm., Waianae, May 20; one, 44 mm., Waianae, September 1. The last differs from Baldwin's water color, as published by Jordan and Evermann, in showing black reflected up on last dorsal and anal rays from black band on caudal peduncle. The dorsals and anals are all olive-brown, whereas the caudal is vivid chrome-yellow. Ventrals grayish in front.

**Microcanthus hawaiiensis** new species

Figures 6 (type) and 7 (Manikuli).

*Chaetodon strigatus* (not Cuvier) Günther, Journ. Mus. Godeffroy, vols. 2-3, pts. 5-6, 1874, p. 47 (Hawaiian Islands).

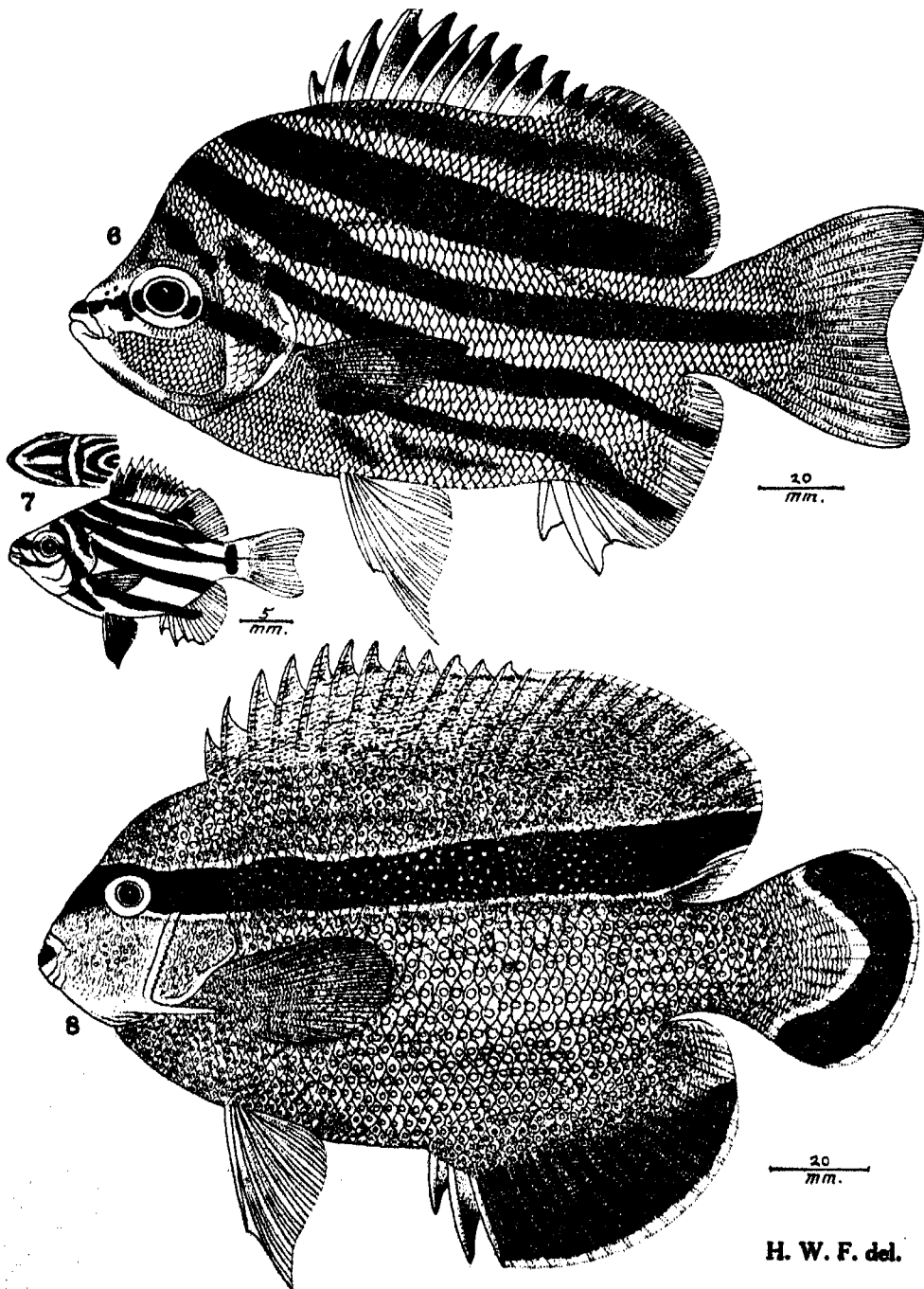
*Microcanthus strigatus* Whitley, Rec. Austral. Mus., vol. 18, no. 3, 1931, p. 112 (reference).—Fowler, Acad. Nat. Sci. Phila. Monographs, no. 2, 1938, p. 229 (Honolulu), p. 287 (reference); Proc. Amer. Phil. Soc., vol. 82, no. 5, 1940, p. 781 (Oahu; Maui).

Depth  $1\frac{1}{2}$  to 2; head  $2\frac{1}{2}$  to 3, width  $1\frac{1}{2}$  to 2. Snout (in profile)  $3\frac{1}{2}$  to  $3\frac{3}{4}$  in head; eye  $2\frac{1}{2}$  to  $2\frac{3}{4}$ , greater than snout or interorbital; maxillary short, reaches  $\frac{1}{4}$  to  $\frac{1}{2}$  to eye, length  $3\frac{1}{2}$  to 5 in head; mouth broad, cleft short, jaws subequal or equal; lips narrow, fleshy, smooth; interorbital  $2\frac{1}{2}$  to  $3\frac{1}{2}$  in head, convex; hind preopercle edge finely denticulate. Gill rakers 3 + 15, lanceolate,  $\frac{1}{2}$  of gill filaments which are  $2\frac{1}{2}$  in eye.

Scales 60 in lateral line to caudal base, counted close above and along its course; pores 40 + 4 in lateral line, slender, simple; 12 scales above lateral line, 26 below. Head largely scaly, muzzle, preorbital and chin naked. Cheek with 12 rows of scales counted vertically. Chest, breast, prepectoral and preventral regions covered with small scales. Soft vertical fins and pectorals basally covered with small or finely crowded scales.

D. XI, 14 to 17, fourth spine  $1\frac{1}{2}$  to  $1\frac{2}{3}$  in head, third ray  $2\frac{1}{2}$  to  $2\frac{3}{4}$ ; A. III, 14 or 15, second spine 2 to  $2\frac{1}{2}$ , second ray 2 to  $2\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{2}$  to  $2\frac{3}{4}$ ; caudal 1 to  $1\frac{1}{4}$ , little emarginate behind; pectoral  $1\frac{1}{2}$  to  $1\frac{3}{4}$ , rays 16; ventral rays I, 5, fin  $1\frac{1}{2}$  to  $1\frac{1}{4}$  in head.

Color in alcohol with ground color white, greatly contrasted by 7 blackish longitudinal bands, parallel, arched little down and backward; uppermost broadly marginal on first dorsal and continued submarginally on second dorsal; second and third bands enter black submargin on second dorsal; fourth band from front predorsal well above eye arches down to middle of caudal base; fifth band from supraoccipital, broken at suprascapula, and reaches posterior rays of anal; sixth band from snout tip through eye down and back to pectoral axil and ends on front anal rays; seventh band as 3 to 5 blackish blotches along lower side of belly. Black blotch above upper front edge of eye. The young differs in having round black spots less than eye at front of first dorsal and another at front of second dorsal, both subbasal. Also black bar from behind maxillary to lower eye edge, also short vertical black bar at caudal base and ventrals black terminally.



FIGS. 6 and 7.—*Microcanthus hawaiiensis* new species. FIG. 8.—*Desmoholacanthus arcuatus* (Gray).



TYPE.—A. N. S. P. no. 69740. Honolulu. Henry W. Fowler. Length 205 mm.

Paratypes.—No. 69741, same data, length 133 mm.; no. 69742, Honolulu, from Bishop Museum, 1901, length 188 mm.; no. 69743, Nanakuli, May 18, 1940, length 31 mm. from Vanderbilt Oahu Survey.

This species approaches *Microcanthus vittatus* (Castelnau) as figured by Whitley<sup>2</sup> in the interrupted white inclined band from the supraoccipital and extending down on the front of the opercle. The arrangement of the bands are quite different from either of those shown in *Microcanthus joyceae* Whitley<sup>3</sup> and *Microcanthus howensis* Whitley.<sup>4</sup> *Microcanthus hawaiiensis* seems to resemble *Microcanthus howensis* also but that species is shown with narrower bands.

(Named for the Hawaiian Islands.)

#### DESMOHOLACANTHUS new genus

TYPE.—*Holacanthus arcuatus* Gray.

Depth nearly half of standard length. Preorbital not free behind, lower edge denticulate. Preopercle edge behind finely denticulate, below with several short spines and large spine at angle entire. Shoulder girdle, above pectoral, finely dentate. Scales with roughly jagged edges, without small auxiliary scales. Very small, irregular, crowded scales on cheek and opercle. Caudal convex behind. Pectoral nearly or quite as long as head. Black band from snout and interorbital to last dorsal rays. Anal and caudal broadly blackish terminally. All of rayed vertical fins with white margins.

Approaches *Apolemichthys* Fraser-Brunner 1933 in its feeble preorbital spines, unarmed interopercle, preopercular spines without deep grooves, small and irregular scales on cheek and the dorsal and anal fins not extended. In these characters both differ from *Holacanthus* Lacépède. *Desmoholacanthus* differs from *Apolemichthys* in its longer body, the denticulated shoulder girdle, the preopercle with a few small spines on its lower edge and its greatly contrasted coloration.

(δεσμός band + *Holacanthus*.)

*Desmoholacanthus arcuatus* (Gray)

Figure 8.

One, 173 mm., off Oahu, July. I have never seen a specimen with the design of black on the end of the caudal fin so deeply notched as shown by Fraser-Brunner<sup>5</sup> in his outline sketch of the type.

*Centropyge potteri* (Jordan and Metz)

One, 115 mm., Waianae.

<sup>2</sup> Rec. Austral. Mus., vol. 18, no. 3, 1931, p. 112, pl. 13, fig. 3.

<sup>3</sup> L. c., p. 111, pl. 13, figs. 4-5 (type locality, "Shell Harbour, New South Wales").

<sup>4</sup> L. c., p. 112, pl. 13, fig. 2 (type locality, Lord Howe Island).

<sup>5</sup> Proc. Zool. Soc. London, 1933, p. 579, text-fig. 19.

**TEUTHIDAE*****Teuthis sandvicensis* (Streets)**

Sixteen, 31 to 49 mm., tide pools near the Blow Hole, April 5; forty-three, 32 to 83 mm., Blow Hole, April 6; two, 88 to 103 mm., Coca Head, May 6; ten, 32 to 42 mm., Nanakuli, May 18; five, 33 to 47 mm., Waianae, May 20; fifteen, 32 to 76 mm., Honolulu market, June; twenty-nine, 31 to 34 mm., off Honolulu, July; three, 30 to 37 mm., Honolulu.

***Teuthis lucillae* (Fowler)**

*Hepatus lucillae* Fowler, Acad. Nat. Sci. Phila. Monographs, no. 2, 1938, p. 231, pl. 10, fig. 23 (type locality, Honolulu).

One, 170 mm., Honolulu. Dorsals and pectorals largely dark brownish medially. Sides of head with inconspicuous small close-set golden spots. The last item agrees with materials recorded from the Philippines (Bagacay Bay, Escarpada Island; Langao Point, Luzon; Sitanki Reef; Tictauan Island) by Fowler and Bean in the evident golden spots on the head and breast as *Hepatus lineolatus* (Valenciennes).<sup>a</sup> That species as figured by Garrett and published by Günther in 1875 shows many longitudinal blue lines on the body and largely transverse ones on the head.

***Teuthis lineolatus* (Valenciennes)**

Figure 9.

One, 124 mm., Honolulu. Differs from any of the finely blue-lined species known to me in its much deeper body in combination with the black spot at last dorsal and anal rays and dark blotch across pectoral base.

***Ctenochaetus strigosus* (Bennett)**

One, 170 mm., Honolulu. Iris blue, eyeball and socket of eye bright orange. Pectoral largely suffused with orange to yellow above, dark below.

**SCORPAENIDAE*****Scorpaenodes parvipinnis* (Garrett)**

One, 30 mm., Honolulu.

***Sebastapistes albo-brunneus* (Günther)**

One, 53 mm., Mogua Reef, July 12.

**POMACENTRIDAE****SEMADASCYLLUS new genus**

TYPE.—*Dascyllus albisella* Gill.

Body deeply ovoid, compressed and back well elevated. Head rather large, deep. Snout very short, broad. Eye large, nearly enters upper front profile, greater than postocular space. Maxillary reaches below front edge

<sup>a</sup> Bull. U. S. Nat. Mus., no. 100, vol. 8, 1929, p. 228.

of eye. Mouth small, terminal, oblique, lower jaw slightly protruding. Suborbital rim very narrow, scaleless. Interorbital broad, very low or scarcely convex. Gill rakers  $5 + 15$ , slender, lanceolate, as long as gill filaments or  $\frac{1}{2}$  of eye. Postocular very narrow, usually scaleless. Preopercle edge very minutely serrate. Scales rather large on body, finely ctenoid, largest on middle of sides. Cheek with 3 rows of scales above preopercle flange. Vertical fins and pectorals scaled basally, these scales all rather large. Lateral line in 2 sections, upper with large simple tubes. Dorsal with 11 or 12 spines, second to fourth longest and subequal, form distinct high extension, nearly equal to body depth in young to  $\frac{3}{4}$  with age, spines all graduated down to last which is shortest. Soft dorsal little smaller than anal. Caudal rounded behind. Anal with 2 spines, second much larger. Pectoral moderate, longer in young. Ventral very long, prominent at all ages. Color largely black, with pearly white transverse band before soft dorsal and anal in young, restricted more to upper side of body with age. Round pearly spot at occiput, more extensive in young.

Distinguished from *Pelochromis* Fowler and Bean 1928 chiefly by the greatly elevated first dorsal fin and the very long ventrals. The very characteristic large pearly white blotch on the side of the body is variable, though in the young is more extensive and may form a complete transverse whitish band. In the present genus the general color is black while in *Pelochromis* the color is olive to dark brown, each scale with a paler center, closely scaled preorbital, infraorbital and postocular, and the soft vertical fins more extensively scaly.

(σφηα streamer or banner + *Dascyllus*; with reference to the elevated front of the spinous dorsal fin.)

**Semadascyllus albisella** (Gill)

Figures 10 and 11 (Honolulu harbor).

*Dascyllus albisella* Gill, Proc. Acad. Nat. Sci. Phila., 1862, p. 149 (type locality, Hawaiian Islands).—Pietschmann, Bull. Bishop Mus., no. 156, 1938, p. 32, pl. 2B (photographs) (Wai manalo).

*Dascyllus trimaculatus* (not Rüppell) Fowler, Mem. Bishop Mus., vol. 10, 1928, p. 305 (type of *Dascyllus albisella* Gill; Honolulu).

*Dascyllus edmondsoni* Pietschmann, Anzeiger Akad. Wiss. Wien, vol. 71, 1934, p. 100 (type locality, Hawaiian Islands); Bishop Mus. Bull., no. 156, 1938, p. 33, pl. 2A (photographs) (Kaaawa).

Three, 16 to 29 mm., Honolulu harbor, May 6; one, 18 mm., Nanakuli, May 18. Color alone seems to be the only contention for *Dascyllus edmondsoni* and this based on an example but 13 mm. long.

**PYCNOCHROMIS** new genus

TYPE.—*Pycnchromis vanderbilti* new species.

Body elongately ovoid, well compressed. Caudal peduncle longer than deep. Head rather long, profiles well convex. Eye large, but little less than postocular space. Maxillary small, reaches only slightly below front eye edge. Mouth small, oblique, gape short, lower jaw protruding in front. Teeth uniserial, feeble, minute. Suborbitals not free, region with single row of scales below eye. Interorbital broadly convex. Preopercle little defined, with hind edge little free. Gill rakers slender, lower 16. Scales large on

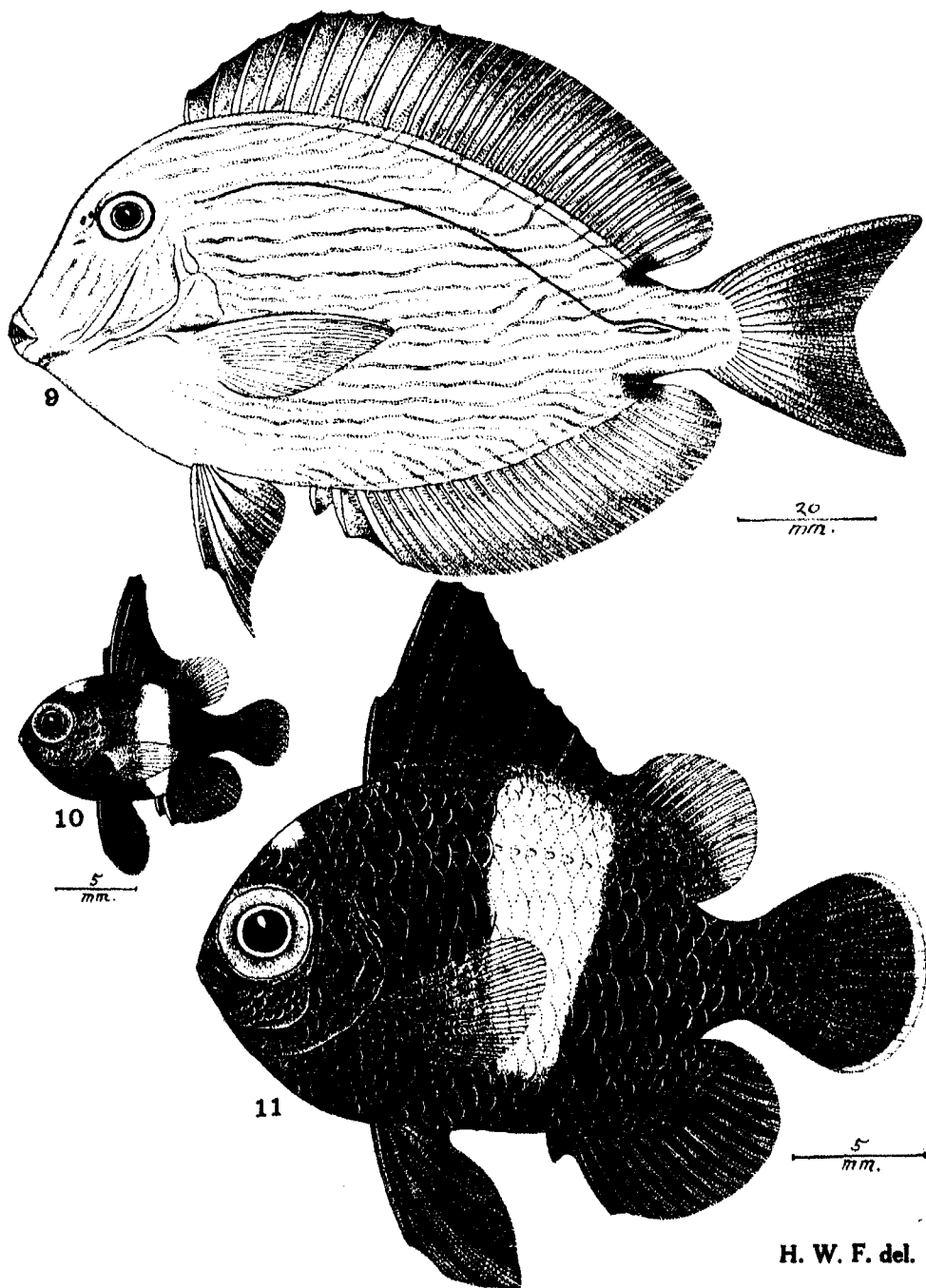


FIG. 9. — *Teuthis lineolatus* (Valenciennes). FIGS. 10 and 11. — *Semadascyllus albisella* (Gill).

body, finely ctenoid, moderate along bases of vertical fins and small ones extend out on caudal medially, also few small ones on pectoral base. Ventral with pointed free axillary scale. Lateral line with upper section distinct, of simple tubes, extends only to front of second dorsal. Dorsal spines 12, rays 11 and base of second dorsal  $1\frac{3}{4}$  in spinous dorsal base. Anal with 2 spines, second greatly longest, fin base little greater than second dorsal fin base. Caudal deeply emarginate, with lobes ending in long slender points. Pectoral reaches vent, inserted below level of eye. Ventral inserted under pectoral base, first ray ends in prolonged point, reaches anal. Each scale usually with small blue spot. Anal and lower caudal border black.

This genus approaches *Chromis* Cuvier, but differs in its more elongated body, very compact head, fewer dorsal spines and the spotted coloration with only the lower caudal border black, the upper largely pale or only black terminally.

(πυκνός compact + *Chromis*; with reference to its very smooth head, the edges of the suborbitals, preopercle and opercle little distinct.)

***Pycnchromis vanderbilti* new species**

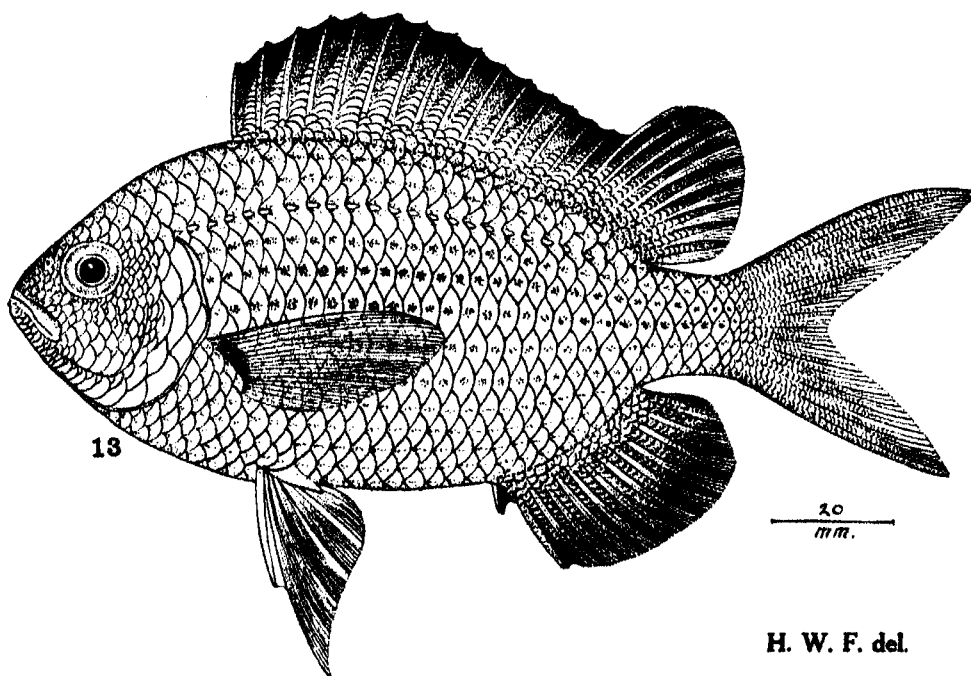
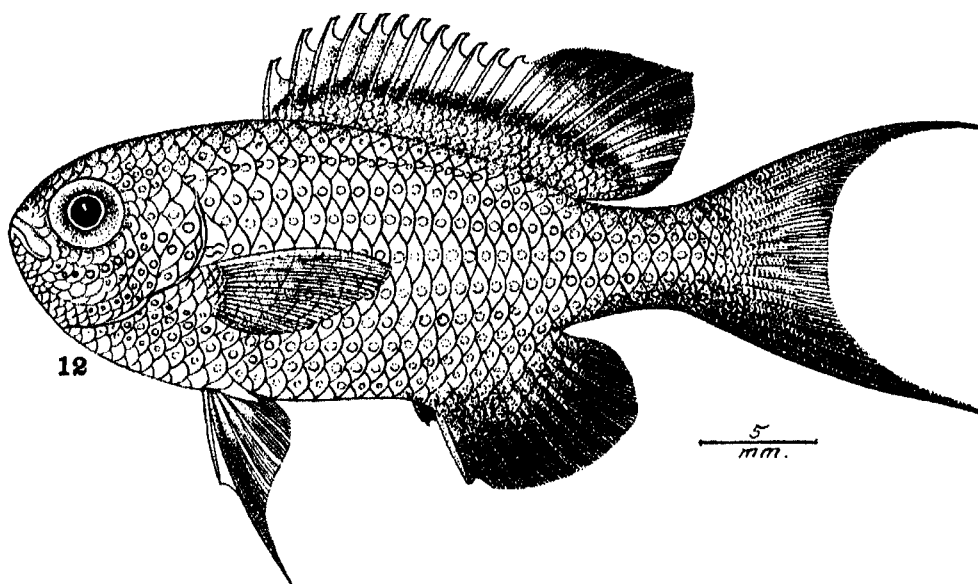
Figure 12.

Depth  $2\frac{3}{4}$ ; head  $3\frac{3}{4}$ , width  $1\frac{3}{4}$ . Snout (in profile) 5 in head, front end nearly level with middle of eye; eye  $2\frac{3}{4}$ , greatly exceeds snout, subequal with interorbital; maxillary reaches  $\frac{1}{10}$  in eye, length  $3\frac{1}{2}$  in head; mouth subvertical; interorbital  $2\frac{3}{4}$ , convex, rather low. Gill rakers  $6 + 16$ , finely lanceolate, as long as gill filaments which are  $\frac{1}{2}$  of eye.

Scales 14 in upper section of lateral line, high; 11 pores in lower straight section; 2 scales above upper section of lateral line to first dorsal origin, 8 below to spinous anal origin; 18 predorsal scales, 10 preventral. Head closely scaled, only lips and front end of snout naked, and scales all smaller on under surface of head. Dorsals with basal third scaly, likewise anal, but on caudal small scales extend well out over basal half of fin. Pectoral base covered with a few small scales. Ventral axillary scale  $3\frac{1}{2}$  in fin.

D. XII, 11, first spine 3 in head, sixth spine  $1\frac{1}{2}$ , twelfth spine  $1\frac{3}{4}$ , first ray  $1\frac{3}{4}$ , sixth ray 1; A. II, 11, second spine 2, first ray  $1\frac{3}{4}$ , fourth ray  $1\frac{1}{2}$ ; least depth of caudal peduncle 2; caudal  $2\frac{1}{10}$  in rest of fish, median rays  $1\frac{3}{4}$  in head, long lobes ending in slender protruded points; pectoral 1, rays 14; ventral rays I, 5, fin  $3\frac{1}{4}$  in fish without caudal, spine 2 in head.

Color in alcohol with body neutral drab, head little more brownish and body scarcely paler below. Iris grayish. Most all scales with whitish or pearly blue spot, variable or largely conforming in size with scale, and some on head have at least darker borders or produce an ocellated appearance. On body spots form longitudinal rows and are less contrasted. Dorsals grayish, darker about upper limits of squamous areas and basally with subdued olive-yellow suffusion. Soft dorsal dark gray terminally. Anal gray-black, with last ray contrasted white. Caudal largely greenish yellow over upper lobe and median rays with suffusion extending forward on caudal peduncle, upper edge basally and end of upper extended point dark gray to blackish. Most of lower caudal lobe gray-black. Paired fins grayish, ventral yellowish buff medially.



H. W. F. del.

FIG. 12.—*Pycnochromis vanderbilti* new species. FIG. 13.—*Thrissochromis velox* (Jenkins).

TYPE.—A. N. S. P. no. 69749. Waianae, Oahu. May 20, 1940. Length 40 mm.

Only the type known. The species is unique in its coloration.  
(Named for Mr. George Vanderbilt.)

**THRISSOCHROMIS** new genus

TYPE.—*Chromis velox* Jenkins.

Body elongately ovoid, compressed, tail somewhat tapering, depth  $\frac{3}{4}$  of standard length. Head moderate, compressed. Snout short. Eye moderate, advanced in head. Maxillary reaches opposite front edge of eye, short. Mouth small, terminal, end of snout level with middle of eye. Teeth small, simple, conic, in narrow bands in each jaw, lower symphyseal pair close-set, little enlarged but hardly longer than others. Preorbital narrow, closely scaled, also check, lower suborbital edge not distinct or free but entire. Interorbital broad, convex. Gill opening extends forward opposite front of eye. Gill rakers 9 + 25, lanceolate, slender, half as long as eye. Scales on head small, especially crowded around eyes. Scales largest on middle of sides, narrowly imbricated. Lateral line in 2 sections, upper ends 4 or 5 scales from caudal peduncle. Vertical fins and pectorals finely scaled over greater portions basally. Axil of ventral with long pointed scale. Scales on chest and breast moderately small. Dorsal spines 14 or 15, rays 11, base of rayed fin  $3\frac{1}{4}$  to 4 in base of spinous fin. Anal spines 2, rays 13, base greatly longer than soft dorsal base. Caudal well forked. Pectoral long, nearly reaches anal, ventral shorter.

Differs from *Demoisellea* Whitley 1928 (= *Furcaria* Poey 1860, not of Lesson 1838) in its increased gill rakers, elongate ovate contour, the extensive spinous dorsal with its membranes entire terminally, squamation and subdued coloration.

( $\theta\pi\iota\varsigma$  bristle, with reference to the gill rakers + *Chromis*.)

**Thrissochromis velox** (Jenkins)

Figure 13.

*Chromis velox* Jenkins, Bull. U. S. Fish Comm., vol. 19, 1899 (1901), p. 393, fig. 6 (type locality, Honolulu).—Fowler, Acad. Nat. Sci. Phila. Monographs, no. 2, 1938, p. 235 (Honolulu), p. 291 (reference).

Two, 105 to 170 mm., Makepu (Honolulu market), mid-June. In these specimens, when fresh in alcohol, dorsals dark gray and anal slate-black. Caudal olivaceous. Lower sides of head and breast gamboge-yellow. Lips orange-red. Paired fins orange-yellow to orange-red.

**Pomacentrus jenkinsi** Jordan and Evermann

*Pomacentrus jenkinsi* Jordan and Evermann, Bull. U. S. Fish Comm., vol. 22, 1902 (1903), p. 189 (type locality, Honolulu; Hilo; Kailua); vol. 23, pt. 1, 1903 (1905), p. 270, fig. 115 (copied Jenkins).

*Pomacentrus inornatus* (not De Vis) Pietschmann, Bull. Bishop Mus., no. 156, Aug. 15, 1938, p. 34 (North Island, Pearl and Hermes Reef).

*Pomacentrus niomatus* (not De Vis) Fowler, Acad. Nat. Sci. Phila. Monographs, no. 2, Oct. 1938, p. 234 (292) (Honolulu; Makepu).

Two, 108 and 109 mm., Makepu (Honolulu market), mid-June; one, 98 mm., Waianae, September 1.

In 1928 I wrongly identified this species with *Pomacentrus niomatus* De Vis. Regan in 1913 has pointed out that *Pomacentrus jenkinsi* "seems to have a broader and a more convex interorbital region, deeper preorbital, and less deeply emarginate caudal fin." Huth's figure, published by Regan as *Pomacentrus inornatus*, does not show the lower section of the lateral line. Likewise Atkinson's drawing, published by Jordan and Evermann, which also differs in that the margin of the spinous dorsal is nearly entire or each membrane scarcely notched terminally. My specimens do not show the large or deep preorbital of Atkinson's drawing. Huth's lithograph of *Pomacentrus inornatus* differs in showing 2 nearly equal rows of scales on the infraorbital, also forming a double row on the preorbital. In my specimens only a single row of large scales, with only a few small accessory scales, besides each large scale marked with a pearl-gray blotch and there is a large gray blotch. Scales on cheek and opercle may each have a more or less pale gray or whitish spot. Blackish blotch terminally on maxillary and in its groove. Lower lip blackish. Most all of pectoral axil blackish, especially above.

***Pomacentrus vanderbilti* new species**

Figure 14.

Depth 2 to  $2\frac{1}{2}$ ; head  $3\frac{1}{2}$  to  $3\frac{3}{4}$ , width  $1\frac{3}{4}$  to  $1\frac{1}{2}$ . Snout (in profile) 4 in head, tip level with lower edge of eye; eye  $2\frac{2}{3}$  to  $2\frac{3}{4}$ , greater than snout, little greater than interorbital; maxillary reaches below front eye edge, length  $3\frac{1}{2}$  to 4 in head; mouth short, wide, jaws even in front; lips thin, smooth; teeth slender, close-set, little curved, uniserial and tip of each truncated; interorbital  $3\frac{1}{2}$  to  $3\frac{3}{4}$ , convex, low; lower infraorbital edge defined, entire; hind preopercle edge denticulated. Gill opening extends forward opposite front eye edge. Gill rakers  $3? + 10$ , slender, lanceolate,  $\frac{2}{3}$  of filaments which are  $\frac{1}{2}$  of eye.

Scales 21 in upper section of lateral line extending until below front of second dorsal; 10 pores in straight section to caudal base; 3 scales above lateral line to first dorsal origin, 11 below to anal origin, 22 to 24 predorsal forward to front of snout. Row of scales on infraorbital and 4 rows on cheek down to lower preopercle edge. Scales on body all narrowly imbricated, little smaller on chest and breast. Vertical fins all densely scaly over greater basal portions. Pectoral with pointed axillary scale.

D. XII, 15 or 16, spinous fin with membranes all deeply notched marginally, first spine  $2\frac{2}{3}$  to  $2\frac{3}{4}$  in head, last spine  $1\frac{1}{2}$  to  $2\frac{1}{4}$ , seventh ray  $1\frac{1}{2}$  to  $1\frac{3}{4}$ ; A. II, 13, second spine 2, eighth ray 1 to  $1\frac{1}{4}$ ; least depth of caudal peduncle  $2\frac{1}{2}$  to  $2\frac{3}{4}$ ; caudal  $2\frac{1}{2}$  to 3 in rest of fish, forked, upper lobe little longer; pectoral 1 to  $1\frac{1}{10}$  in head, rays 16; ventral I, 5, spine  $1\frac{3}{4}$  to  $1\frac{1}{2}$ , fin  $2\frac{1}{2}$  to 3 in fish without caudal.

Color in alcohol olive-brown, little paler on under surfaces. Head with many variable large pearly blue spots, especially on opercle and shoulder girdle. Each scale on body, except predorsal, chest and breast, with pearly blue spot and on sides of body followed or adjoins dark to gray-black spot or short streak, producing a series of dark diagonal lines, all regularly crossing to give design of vertical rhombs. Variable small spots scattered all



over scaly basal areas of vertical fins, prebasal region of pectoral. Iris gray-brown. Dorsals gray-black on spinous fin terminally, first 2 membranes black and outer parts of soft dorsal dark gray. Anal gray-black to black. Caudal yellowish green, also yellowish green tinge on soft dorsal basally. Pectoral pale olive, with small black spot at origin above. Ventral grayish, blackish terminally.

TYPE.—A. N. S. P. no. 69752. Waianae, Oahu. September 1, 1940. Length 56 mm.

Paratypes.—A. N. S. P. no. 69753. Waianae, May 20, length 38 mm.; no. 69754, Mogua Reef, July 12, length 47 mm.; nos. 69755 and 69756, Waianae, July 17, length 42 to 58 mm.

A very distinctive and beautiful fish, known chiefly by its coloration, unlike that of any other Hawaiian pomacentrid. Variation in color is noticeable as some of the specimens are quite dark.

(Named for Mr. George Vanderbilt.)

***Abudefduf sordidus* (Forskål)**

Sixteen, 39 to 80 mm., tide pools at Blow Hole, April 6; two, 76 to 82 mm., Waianae; two, 40 to 58 mm., Waianae, May 18; one, 39 mm., Nanakuli, May 18; one, 32 mm., Honolulu market, June; nine, 25 to 65 mm., Blow Hole, June; three, 46 to 80 mm., Waianae, July 17; six, 47 to 66 mm., Makepu (Honolulu market), mid-June; three, 47 to 92 mm., Kaena Point, August 12.

***Abudefduf abdominalis* (Quoy and Gaimard)**

Six, 23 to 50 mm., Kaena Point, August 12.

**PTEROCYCLOSOMA new genus**

TYPE.—*Glyphisodon sindonis* Jordan and Evermann.

Body deeply ovoid, compressed. Head small, front profile steep, rounded. Mouth small, terminally inferior, falls below level of eye. Teeth in jaws compact, uniform, close-set, conic, pointed, uniserial, not directed or flaring outward. Preorbital small, greatly less than eye. Suborbital and preopercle edges entire. Muzzle naked, inclusive of maxillary and chin. Gill rakers short, length  $\frac{2}{3}$  of gill filaments which are  $1\frac{1}{2}$  in eye, and lower rakers 10 in number. Scales on body rather large, narrowly imbricated, smaller on tail and without small accessory scales. Vertical fins and pectoral scaly basally. Long pointed axillary scale. Lateral line in 2 sections, separated by 2 rows of scales at intersection; 3 or 4 scales above end of upper section to base of second dorsal fin. Dorsal spines 12, rays 19, base of spinous fin but little longer than base of rayed fin. Anal spines 2, rays 15.

Differs from *Abudefduf* Forskål chiefly in its conic teeth, increased dorsal and anal rays, and its contrasted distinctive coloration. Its affinities are perhaps more close to this genus than any other.

( $\pi\tau\epsilon\rho\acute{o}\nu$  fin +  $\kappa\acute{\upsilon}\kappa\lambda\omicron\varsigma$  orb, with reference to the circular body +  $\sigma\acute{\omega}\rho\alpha$  body).

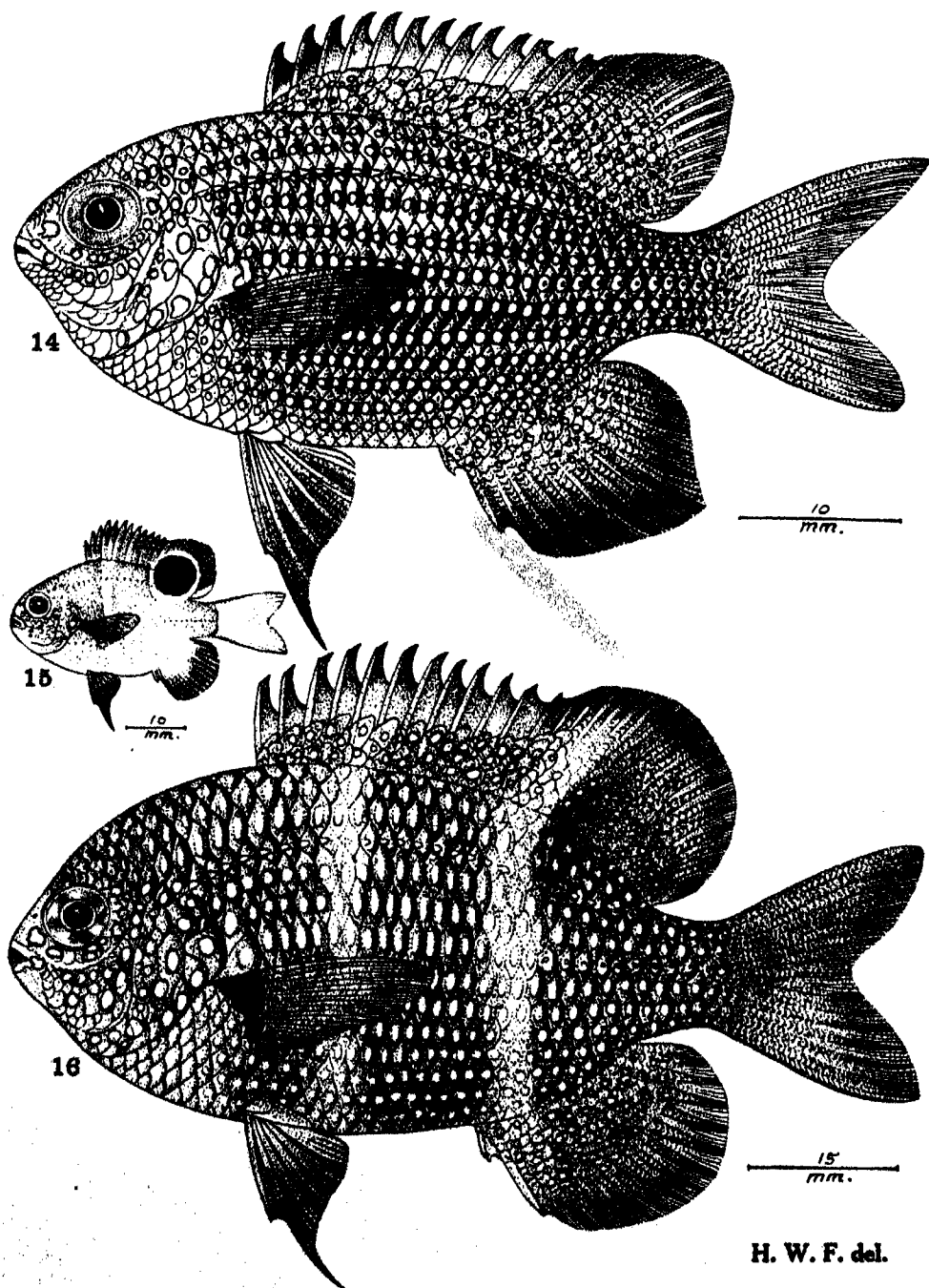


FIG. 14.—*Pomacentrus vanderbilti* new species. FIGS. 15 and 16.—*Pterocyclosoma sindonis* (Jordan and Evermann).

**Pterocyclosoma sindonis** (Jordan and Evermann)

Figures 15 and 16.

*Glyphisodon sindonis* Jordan and Evermann, Bull. U. S. Fish Comm., vol. 22, 1902 (1903), p. 188 (type locality, Honolulu; Kailua); vol. 23, pt. 1, 1903 (1905), pl. 40 (types).

*Abudefduf sindonis* Jordan and Evermann, op. cit., vol. 22, pt. 1, 1903 (1905), p. 272 (types).

*Chromis sindonis* Fowler, Mem. Bishop Mus., vol. 10, 1928, p. 309 (Hawaii; type); Acad. Nat. Sci. Phila. Monographs, no. 2, 1938, p. 291 (reference).

One, 53 mm., Waianae, May 20. Large black dorsal ocellus greater than eye, ringed with pearl-gray in front and behind. On body 2 pearl-gray transverse bars on body. Middle of each caudal lobe yellowish, fin edged all around with dark gray.

One, 73 mm., Waianae, June 17; two, 45 to 92 mm., Mogua Reef, July 12; one, 50 mm., Waianae, September 1, anterior transverse pearly band little defined. Compared with Morita's rather poor wash drawing, published as *Glyphisodon sindonis* by Jordan and Evermann, that figure shows the species crudely. It fails to show large gray spots on the sides of the head and preorbital, the lower posterior section of the lateral line is not indicated, the preorbital far too deep and the axillary scale of the ventral apparently too short. It is also quite evident that the description by Jordan and Evermann in 1905 stating that "a large black ocellated spot with a narrow white border on back and lower part of soft dorsal larger than eye, just back of last white bar" does not belong in "the description based on the type."

**OLIGLYPHISODON** new genus

TYPE.—*Glyphisodon imparipennis* Vaillant and Sauvage.

Body ovoid, well compressed. Head moderate, compressed, deep. Snout short, broad. Eye moderate, supero-lateral, premedian in head. Maxillary reaches below front of eye, short, with snout tip level with lower edge of eye. Mouth small, gape short, inclined, jaws even, upper jaw not protractile. Teeth compressed, close-set, slender, end of each with slight terminal emargination. Interorbital broad, low, convex. Infraorbital and preopercle edges distinct, entire. Gill opening extends forward opposite hind edge of eye. Gill rakers lanceolate, short,  $\frac{1}{2}$  of gill filaments which are  $\frac{3}{4}$  of eye, number 7 below. Scales large, finely ctenoid. Cheek with 3 rows of scales besides additional row on infraorbitals. Bases of vertical fins and pectorals scaly, caudal more extensively scaled with fine small scales. Lateral line in 2 sections, upper of large simple tubes extends below middle of second dorsal. First dorsal highest in front, with 12 spines and base of spinous fin nearly twice as long as second dorsal and membranes of spinous fin but little notched marginally. Dorsal rays 15 or 16. Anal with 2 spines and 11 rays. Caudal forked, lobes subequal or lower little shorter. Pectoral small, short, less than head. Ventral subequal with pectoral. Color olive above, sides and below paler, with tail largely yellowish.

Distinguished from *Abudefduf* chiefly by its reduced gill rakers.

(ὀλίγος few + *Glyphisodon*; with reference to the gill rakers.)

**Oliglyphisodon imparipennis** (Vaillant and Sauvage)      Figure 17 (Waianae).

*Glyphisodon imparipennis* Vaillant and Sauvage, Rev. Mag. Zool., ser. 3, vol. 3, 1875, p. 279 (type locality, Honolulu).

*Abudefduf imparipennis* Fowler, Acad. Nat. Sci. Phila. Monographs, no. 2, 1938, p. 236 (Makepu; Diamond Head), p. 293 (reference).

Color in alcohol with head above and back anteriorly gray-brown or olive, inclining to pale greenish on sides and posteriorly and over caudal buff to pale orange. Under surface of body and head whitish, with pinkish tinge on under surface of head, along edge of abdomen and especially along anal base, where more vivid. On body at scale junctures dull yellowish longitudinal bands. Iris olive-buff, with vertical dark gray blackish bar. Dorsals dull olive-brown, edge of spinous fin narrowly gray-black, soft dorsal tinged with buff. Pectoral olive-buff, pink basally. Ventral pink.

The smallest specimen shows a pearly bar across the under surface of the head transversely and usually reaching up to each eye. Sometimes this is only a pearly spot below the eye. Others are a little larger and may have a pearl-blue bar from the front. Some small examples may also have a pearly spot on each scale exposure on the lower sides and under parts of the body.

Three, 53 to 57 mm., Waianae, April 20; one, 59 mm., Blow Hole, April 5; four, 40 to 55 mm., Coca Head, May 6; thirty-three, 20 to 64 mm., Waianae, May 20; nine, 50 to 58 mm., Waianae, June; two, 36 to 54 mm., off Oahu, July; one, 58 mm., Mogua Reef, July 12; seventeen, 26 to 62 mm., Waianae, July 17.

#### LABRIDAE

**Coris gaimard** (Quoy and Gaimard)

Two, 255 to 270 mm., Honolulu market, June.

**Gomphosus tricolor** (Quoy and Gaimard)

Color in alcohol, head rose-maroon to brown. Body dark olivaceous-gray, each scale with pearly blue vertical bar, edged in front with darker blue spot. Dorsals, anal and caudal posteriorly golden-orange, basal scalation dark blue to similar color of back. Broad gamboge-golden bar from supra-scapula down including basal half of pectoral, which is crossed by oblique median dark blue band and hind border dark gray. Ventral olive basally, dark gray terminally.

One, 235 mm., off Oahu, July.

**Stethojulis axillaris** (Quoy and Gaimard)

One, 55 mm., Blow Hole, April 5, 2 black spots, one above the other, on caudal base; one, 45 mm., Blow Hole, April 6; five, 44 to 74 mm., Waianae, April 20, some with only single ocellated black spot on caudal peduncle.

Color largely bright orange-red. Dark rose-brown streak begins at median black spot on front of snout, arches along upper edge of eye then

along course of lateral line to bases of upper caudal rays, marked in its course along back by 5 nearly equidistant pearly rose or rose-lilac blotches. Vertical fins orange-red, with usually black ocelli on last rays. Two usual black spots at caudal base. Scarlet bar along pectoral base. Ventral golden. Head above and back marked with numerous gray dots. One, 47 mm., Waianae, May 20. Also 4 others, 33 to 49 mm., same data, with variable black caudal spots, 2 or 3 on one side or the other.

Two, 27 to 62 mm., Blow Hole, June. Variable in having not only upper surface of head finely dotted with gray-white but also entire back below dorsal fins. Black spot present on upper (right) side of caudal peduncle, none on left side. A second round black spot on lateral line one scale in advance of usual one. Another 59 mm., same data, largely golden. Dorsals and anal bright golden-orange. Golden-yellow band separates dark warm brown band on side of snout and postorbital, embraces jaws and along infraorbitals back to opercle. Whole upper surface of head dotted with dark gray and median blue-black spot on front edge of snout above. Orange-buff blotch above pectoral base. On body and traversing each row of scales deeper golden to gamboge longitudinal band. Black spots on dorsals, anal and caudal basally as on above specimens. Caudal orange, with narrow whitish edge posteriorly.

One, 73 mm., Makepu (Honolulu market), mid-June.

Color in alcohol largely golden-brown on small examples, larger ones lilac. Snout orange. Lower half of head golden-yellow, usually separated by pearly gray or light blue horizontal line from along lower eye edge. Postocular surface of head with small numerous close-set gray spots. Indistinct dark brown or rose-brown streak from above eye back to suprascapula. Sometimes throat and breast dark rose. Median small black spot, less than pupil, on upper front edge of snout. Iris pink to rose. Dorsals orange to dusky orange, usually little darker terminally and soft dorsal with narrow gray-white edge; black golden edged ocellus on last membrane of soft dorsal. Anal yellow or golden basally, with median dark gray longitudinal band, outer border of fin pale to whitish or gray-white; black golden edged ocellus on last membrane of fin. Caudal golden or vermilion-orange basally, whole fin suffused with orange or red. Round black spot close above lateral line on caudal base in smaller specimens; in larger another similar black spot on lateral line and therefore little below its level. Small example with oblique rose colored bar, in larger rose-brown bar. Paired fins pale yellow, more or less dark gray terminally in larger ones. Five, 32 to 42 mm., Mogua Reef, July 12.

*Halichoeres ornatus* (Garrett)

Figure 18 (off Oahu).

One, 25 mm., Waianae, April 20. Third black dorsal spot similarly advanced on soft dorsal as following.

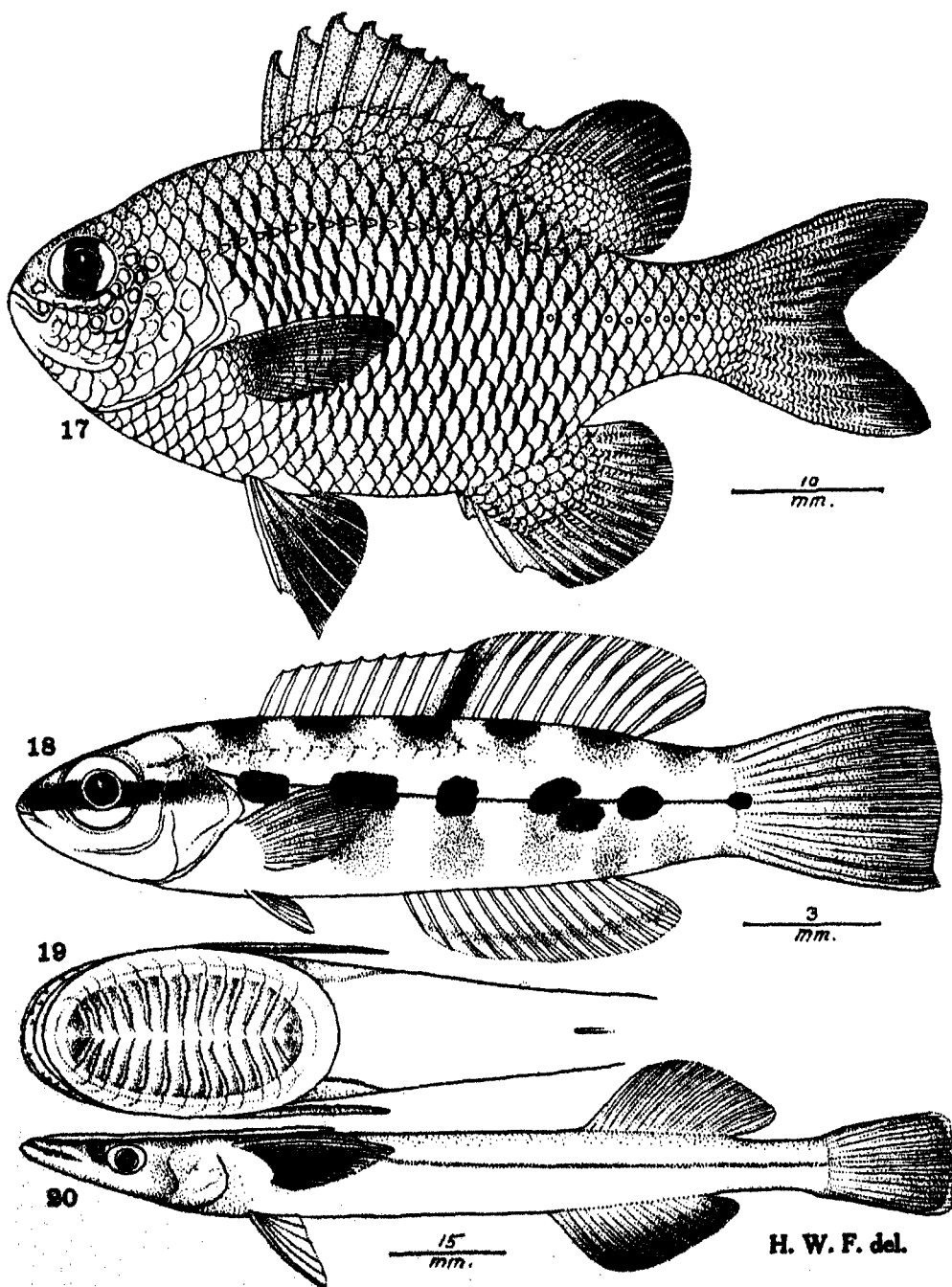


FIG. 17.—*Oliglyphisodon imparipennis* (Vaillant and Sauvage). FIG. 18.—*Halichoeres ornatus* (Garrett). FIGS. 19 and 20.—*Remorina albescens* (Schlegel).

One, 20 mm., off Oahu, July. Color in alcohol bright olive-buff, fins and snout more or less golden-orange. Along each side of back row of 6 large blackish blotches and along middle of side row of 6, last small and at caudal base. Small black spot at hind eye edge. Iris pink.

One, 28 mm., Mogua Reef, July 12. Largely pale buff-brown, rose below. Iris rose. Fins yellowish buff. Dorsals with 3 black blotches, first on first membrane of spinous dorsal, second at front of soft dorsal and third median on soft dorsal.

***Thalassoma duperrey* (Quoy and Gaimard)**

Two, 45 to 51 mm., Waianae, April 20; six, 37 to 51 mm., Waianae, May 20; two, 40 to 50 mm., Honolulu market, June; four, 26 to 54 mm., Mogua Reef, July 12; one, 33 mm., Waianae, July 17; two, 37 to 47 mm., Waianae, September 1.

I feel convinced that *Pseudojulis trifasciatus* Pietschmann 1938, with 2 photographs, is wrongly identified with Weber's species of that name published in 1913 and is really the young of *Thalassoma duperrey*. Pietschmann's photograph of his larger specimen shows with certainty these details as 4 scales intervene between the bases of pectoral and ventral fins, black spot at tip of snout and another at pectoral origin.

***Thalassoma umbrostygmia* (Rüppell)**

Color in alcohol with back olivaceous, with greenish to grayish tints. Six darker blotches along back, each scale with deep rose-maroon to brown blotch; alternating down on sides, 5 dark blotches made up of similar blotches, 1 on each scale and scales in paler intervals with pale rose bar or border, appearing to form longitudinal pink bands. Head olive-brown above, sides greenish, with dark purple-brown bars and spots, more or less with bordering rose lines. Spots and bars on head very variable and in some specimens lower one rose-pink. Jaws and lips tinged with orange, sometimes all muzzle, head below and sides suffused with orange. Often lower surfaces bright chrome-yellow and pink or rose band inclined along and below pectoral base. Iris rose-brown or orange. Dorsals green, with median orange-vermilion band and with border of same color, edge above narrowly pale to white. Anal vermilion, rose basally and orange terminally, with broad median longitudinal golden-chrome band and narrow lower edge of fin white. Caudal vermilion at base and below, also variably on rays, otherwise fin golden-yellow, upper and lower corners and hind edge narrowly whitish. Pectoral yellow basally, orange over greater outer half and with small black spot in axil above and at fin origin. Ventral chrome-yellow.

One, 46 mm., Blow Hole, April 5; five, 57 to 83 mm., Waianae, April 20; two, 99 to 100 mm., Coco Head, May 6; nine, 35 to 63 mm., Waianae, May 20; five, 40 to 80 mm., Honolulu market, June; eight, 46 to 75 mm., Makepu (Honolulu market), mid-June; two, 63 to 88 mm., Mogua Reef, July 12; thirty-two, 30 to 104 mm., Waianae, July 17; six, 32 to 72 mm., Kaena Point, August 12; one, 47 mm., Waianae, September 1.

**Cymolutes lecluse** (Quoy and Gaimard)

Three, 145 to 152 mm., Blow Hole, June. All show margins of dorsals and anals orange-yellow. Iris orange, ringed with dark rose.

**Hemipteronotus melanops** (Bleeker)

One, 228 mm., Honolulu market, June.

While making comparative studies in this family I discovered the following:

**PSEUDOJULOPS** new genus

TYPE.—*Pseudojulus trifasciatus* Weber.

Body elongately ovoid, depth  $3\frac{1}{2}$ , trunk short. Head  $2\frac{1}{2}$ , obtuse. Snout short, convex. Eye large, greater than snout, with snout tip level with eye center. Mouth cleft reaches opposite front eye edge (maxillary apparently shown in Weber's figure reaching first  $\frac{2}{3}$  in eye diameter, leaving very narrow infraorbital). Interorbital moderately elevated above eye. Preopercle distinct. Scales 27 in continuous lateral line (26 pores on Weber's figure), 2 scales above to spinous dorsal origin, 5 above anal origin to lateral line, 6? preventral scales, 4 predorsal and single scale between pectoral and ventral fin bases. Dorsal with 9 spines forming lower spinous fin than second dorsal which has 12 rays. Anal spines 3, rays 10. Length of caudal peduncle less than its least depth. Caudal truncate, shorter than head. Pectoral reaches anal, low. Ventral but little shorter than pectoral. Broad brown band from snout end through eye to base of upper half of caudal, and another from between eyes embraces dorsal fins basally, becoming narrow posteriorly.

Differs from *Pseudojulus* Bleeker in its entirely different squamation; that genus with its genotype figured by Bleeker with very small scales on its predorsal, chest, breast, belly and caudal base. Moreover the facies of its head is very different, with a long low muzzle, and the dark or black lateral band beginning high or above the upper hind eye edge, also embracing the lateral line along the caudal peduncle. The monotypic species *Pseudojulops trifasciatus* (Weber).<sup>†</sup>

(*Pseudojulus* +  $\psi$  appearance.)

**ELEOTRIDAE****Asterropterix semipunctatus** Rüppell

One, 36 mm., Honolulu harbor, May 6.

**Gobiidae****Gobius fuscus** Rüppell

Eight, 27 to 54 mm., Blow Hole, April 5; seventeen, 30 to 90 mm., Blow Hole, April 6; one, 26 mm., Waianae, April 20; one, 90 mm., Nanakuli,

<sup>†</sup> *Pseudojulus trifasciatus* Weber, "Siboga" Exped., vol. 52, Fische, 1913, p. 380, fig. 76 (type locality, Karkaralong Island; Nalahia; Tiur Island).



May 18; one, 69 mm., Honolulu market, June; five, 33 to 115 mm., Makepu (Honolulu market), June; two, both 20 mm., Blow Hole, June; one, 30 mm., off Oahu, July.

*Vitraria clarescens* Jordan and Evermann

Two, 26 to 30 mm., Honolulu, May 6.

*Kelloggella oligolepis* (Jenkins)

One, 26 mm., Blow Hole, April 5.

### ECHENEIDAE

*Remorina albescens* (Schlegel)

Figures 19 (head above) and 20.

*Echeneis albescens* Schlegel, Fauna Japonica, Poiss., pt. 15, 1850, p. 272, pl. 120, fig. 4 (type locality, Japan).—Fowler, Mem. Bishop Mus., vol. 10, 1928, p. 419 (reference); Proc. U. S. Nat. Mus., vol. 80, art. 6, 1932, p. 12 (Shavy Bay, Ua Huka, Marquesas, on *Manta birostris*); Mem. Bishop Mus., vol. 11, no. 6, 1934, p. 444 (reference); Acad. Nat. Sci. Phila. Monographs, no. 2, 1938, p. 259 (Galapagos records), p. 299 (reference).

*Remora albescens* Fowler, The Fish Culturist, vol. 14, no. 5, Jan. 1935, p. 115, fig. (Brielle, N. J., on *Manta birostris*).

*Echeneis clypeata* Fowler, Mem. Bishop Mus., vol. 10, 1928, p. 419 (copied Günther).

One, 59 mm., taken by light at night off Diamond Head, September 10. An interesting addition to the Hawaiian fauna.

*Remora remora* (Linnaeus)

Figures 21 (head above) and 22.

*Echeneis remora* Linnaeus, Syst. Nat., ed. 10, pt. 1, 1758, p. 260 (type locality, "in Pelago Indico").—Fowler, Acad. Nat. Sci. Phila. Monographs, no. 2, 1938, pp. 61, 259 (Galapagos Islands), p. 299 (reference).

Eleven, 74 to 177 mm., off Oahu, May-June.

*Remoropsis pallidus* (Schlegel)

Figures 23 (head above) and 24.

*Echeneis pallida* Schlegel, Fauna Japonica, Poiss., pt. 15, 1850, p. 271, pl. 170, fig. 2 (type locality, "mers du Japon").

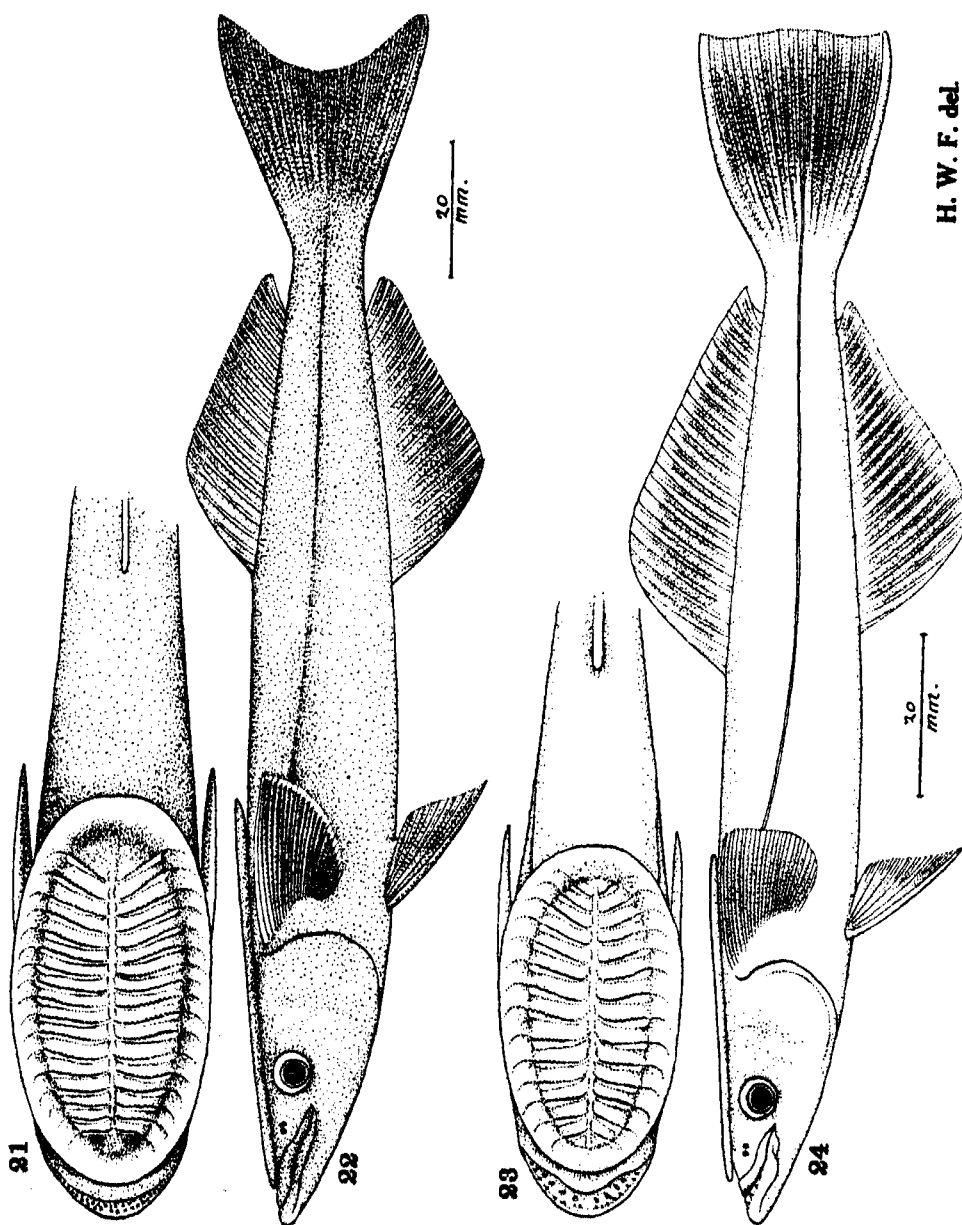
*Echeneis nieuhofti* Bleeker, Nat. Tijds. Ned. Indie, vol. 4, 1853, p. 279 (type locality, Priaman, in mari, Sumatra).

*Remora nieuhofti* Fowler, Journ. Acad. Nat. Sci. Phila., ser. 2, vol. 12, 1904, p. 552 (Padang, Sumatra).

One, 143 mm., off Oahu, May-June, from marlin or shark. General color when fresh in alcohol light yellowish buff, of nearly uniform bright appearance. Iris gray-buff. Disk light yellowish buff. Dorsal, anal and caudal grayish over greater median areas, margins and bases all around pale. Paired fins sprinkled with grayish dots.

This remora is conspicuous among all those collected by its bright yellowish buff color. It approaches most closely to *Remoropsis brachyptera* (Lowe) as figured by Goode<sup>a</sup> but with a different shaped and shorter pectoral, shorter interdorsal space, slightly double concave caudal and different coloration. *Echeneis pallida* is described by Schlegel from 2 speci-

<sup>a</sup> Fisher. Industr. U. S., sect. 1, 1884, pl. 177, lower fig. (collected at sea in 250 fathoms).



FIGS. 21 and 22. — *Remora remora* (Linnaeus). FIGS. 23 and 24. — *Remoropsis pallidus* (Schlegel).

mens 137 to 150 mm. long, the disk with 16 or 17 lamellae (16 on figure) and very light uniform brown. Schlegel's figure differs from my specimen in its deeper body, longer interdorsal space, the lower pectoral rays comparatively shorter and its coloration shown as uniform. Important points in agreement are the length of the depressed pectoral and its slight extension behind the disk, lower dorsal with its origin slightly in advance of the anal origin or over the vent and the slightly double concave hind caudal edge. The pectoral fins in my specimen are extended outward laterally and do not readily fold back against the body, so that it may readily avail to the artist to foreshorten the lower rays, even though his figure thus conveys the impression the fin is depressed flat against the body. Possibly the gray color of the vertical fins, very distinct in my specimen, may have entirely faded in his.

An interesting comparison is afforded by the specimen 170 mm. long I recorded in 1904 from Padang as *Remora nieuhoii*. It is slightly darker in color but with all the structural details noted above and shown by the figured Hawaiian specimen. It differs in the shorter ventrals reaching  $2\frac{1}{2}$  times to the anal origin. Schlegel's figure of his *Echeneis pallida* would also show  $2\frac{1}{2}$ . There is now scarcely a trace of the median grayish areas on the vertical fins.

**Remoropsis brachypterus** (Lowe)

Figures 25 (head above) and 26.

*Echeneis brachyptera* Lowe, Proc. Zool. Soc. London, 1839, p. 89 (type locality, Madeira).

*Remora brachyptera* Fowler, Bull. Amer. Mus. Nat. Hist., vol. 70, pt. 2, 1936, p. 1020, fig. 420 (outline) (copied), p. 1321 (reference).

Four, 172 to 189 mm., off Oahu, May-June, all from marlins and sharks. One of largest shows some of the lamellae of the disk atrophied.

The present species may be distinguished from *Remoropsis pallidus* (Schlegel) chiefly by the pectoral with half its length extended behind the cephalic disk, and by the shape of that fin with the upper rays forming the hind margin obliquely down and backward, and its greater interdorsal space.

**Rhombochirus osteochir** (Cuvier)

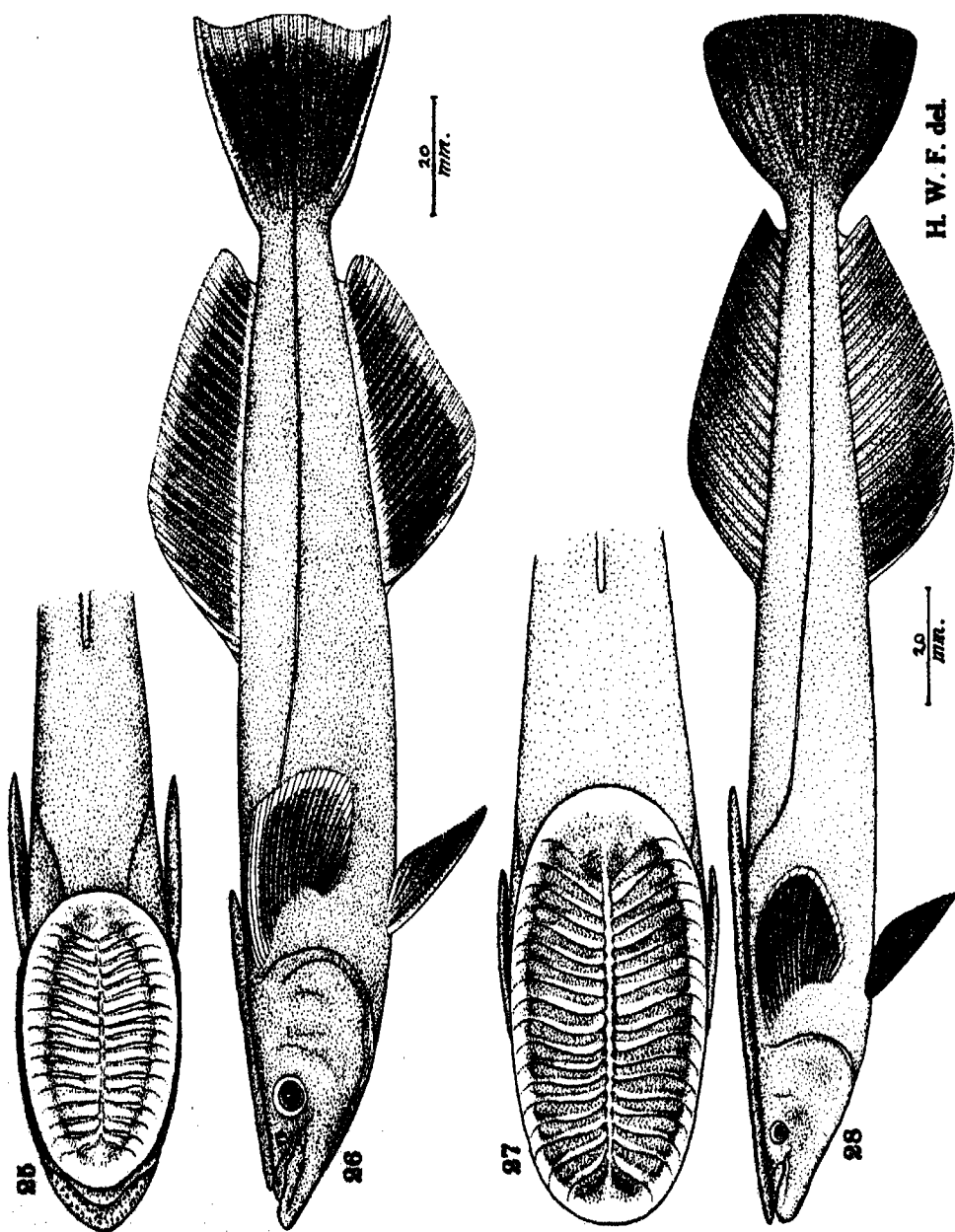
Figures 27 (head above) and 28.

*Echeneis osteochir* Cuvier, Règne Animal, ed. 2, vol. 2, 1829, p. 348 (type locality, no locality).

*Rhombochirus osteochir* Fowler, Acad. Nat. Sci. Phila. Monographs, no. 2, 1938, p. 61 (Galapagos Islands).

*Remoropsis brachyptera* (not Lowe) Fowler, Occas. Pap. Bishop Mus., vol. 10, no. 7, 1923, p. 387 (Honolulu); Mem. Bishop Mus., vol. 10, 1928, p. 421 (Honolulu specimen); Acad. Nat. Sci. Phila. Monographs, no. 2, 1938, p. 299 (reference).

Fourteen, 79 to 310 mm., off Oahu, May-June, from marlin, lamellae in disk 17 to 19; three, 179 to 410 mm., off Oahu, June, lamellae 18; one, 318 mm., cruiser "Wiki Wiki", June 6, from striped marlin.



FIGS. 25 and 26.—*Remoropsis brachypterus* (Lowe). FIGS. 27 and 28.—*Rhombachirus osteochir* (Cuvier).

**BLENNIIDAE*****Cirripectus variolosus*** (Valenciennes)

General color in alcohol black, caudal gray-white over greater upper portion of upper lobe. Sides of head and flanks marked with obscure scattered small round gray spots or dots. One, 45 mm., Waianae, July 17.

*Exallias obscurus* Borodin 1927 agrees in most all details except it is figured without a pale or light area on the upper marginal part of the caudal fin.

***Salarias zebra*** (Vaillant and Sauvage)

Figure 29 (Blow Hole).

Two, 25 to 69 mm., Blow Hole, April 5; twenty-three, 58 to 131 mm., Blow Hole, April 6; one, 88 mm., Blow Hole, June; four, 30 to 78 mm., Makepu (Honolulu market), June; one, 119 mm., Mogua Reef, July 21; two, 52 to 54 mm., Kaena Point, August 12.

***Salarias marmoratus*** (Bennett)

One, 76 mm., Makepu (Honolulu market), mid-June; two, 83 to 85 mm., Waianae, June 17; one, 108 mm., off Oahu, July.

**TRICHONOTIDAE*****Crystallodytes cooki*** Fowler

One, 45 mm., Waianae, July 17; four, 44 to 49 mm., Waianae, September 1.

**BALISTIDAE*****Balistapus aculeatus*** (Linnaeus)

One, 62 mm., off Oahu, July.

**MONACANTHIDAE*****Monacanthus spilosoma*** Lay and Bennett

One, 65 mm., off Oahu, June. Color when fresh in alcohol with entire sides of body crimson. Caudal orange.

**CANTHIGASTERIDAE*****Canthigaster amboinensis*** (Bleeker)

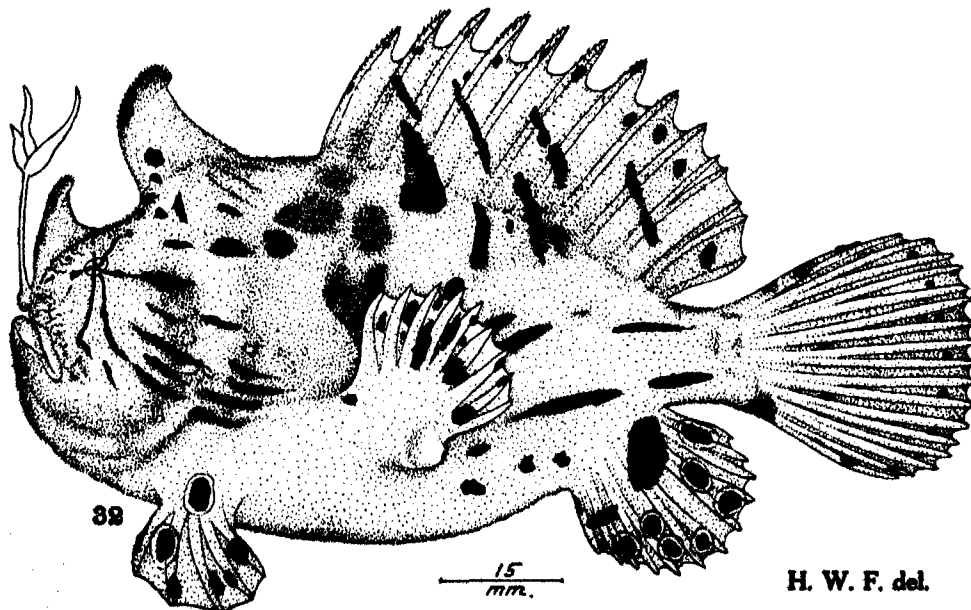
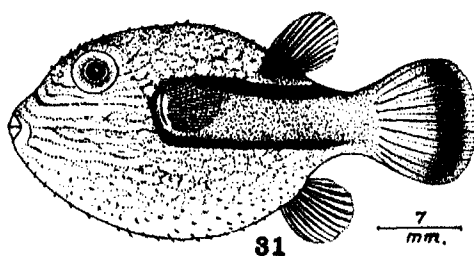
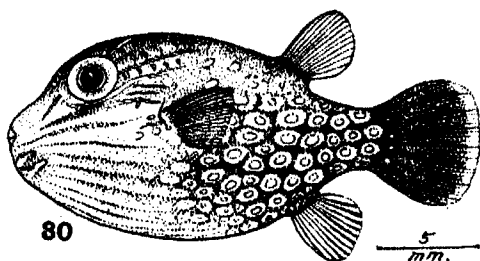
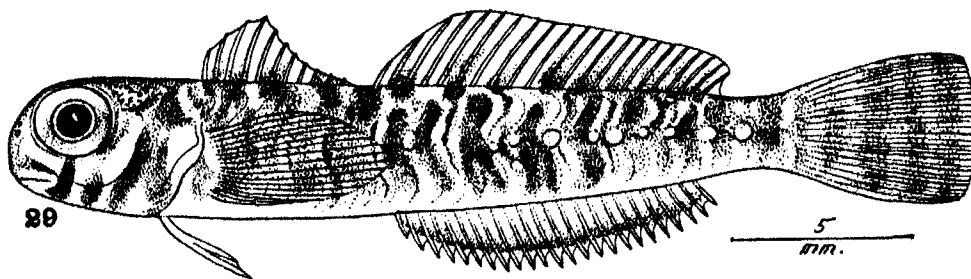
Figure 30 (Waianae).

*Psilonotus amboinensis* Bleeker, Nederl. Tijds. Dierk., vol. 2, 1865, p. 180 (type locality, Amboina).

*Canthigaster amboinensis* Fowler, Mem. Bishop Mus., vol. 10, 1928, p. 465 (Honolulu; Fiji; types of *Tropidichthys oahuensis* and *T. psegma*; Maui); Acad. Nat. Sci. Phila. Monographs, no. 2, 1938, p. 303 (reference).

*Canthigaster polyophthalmus* Pietschmann, Bull. Bishop Mus., no. 156, 1938, p. 51, pl. 1C (Molokai, Kaupoa).

One, 26 mm., Waianae, July 17, dark olive-brown with pearly gray to blue spots on body; one, 104 mm., Mokeilea, May 6.



H. W. F. del.

FIG. 29.—*Salaria zebra* (Vaillant and Sauvage). FIG. 30.—*Canthigaster amboinensis* (Bleeker). FIG. 31.—*Canthigaster notospilus* new species. FIG. 32.—*Antennarius cunninghami* new species.

*Canthigaster notospilus* new species

Figure 31.

Depth (contracted)  $1\frac{3}{4}$  to  $1\frac{1}{2}$ ; head  $2\frac{1}{4}$  to  $2\frac{3}{4}$ , width  $1\frac{1}{2}$  to  $1\frac{1}{4}$ . Snout 2 to  $2\frac{1}{2}$  in head; eye  $2\frac{1}{4}$  to  $3\frac{1}{6}$ ,  $1\frac{1}{2}$  to  $1\frac{1}{4}$  in snout, subequal with to slightly greater than interorbital; mouth small, terminal, closed jaws with tip of upper well below level of upper jaw tip; lips smooth, entire; teeth with entire cutting edges; interorbital 3 to  $3\frac{1}{2}$  in head, low, little concave. Gill opening close before pectoral,  $1\frac{1}{2}$  to  $1\frac{1}{4}$  in eye.

Body largely with feeble though short scattered spines, on back and belly, little evident on sides of tail.

D. 10 to 12, base less than height which is  $2\frac{1}{2}$  to  $2\frac{3}{4}$  in head; A. 10 to 12, similar to dorsal, little posterior, fin height  $2\frac{1}{2}$  to  $3\frac{1}{4}$ ; least depth of caudal peduncle  $2\frac{1}{2}$  to  $3\frac{1}{4}$ ; caudal  $1\frac{1}{2}$  to  $1\frac{1}{4}$ , convex behind; pectoral rays 14 to 16.

Color in alcohol drab or gray-brown, under surfaces pale to white. On head dark drab lines from snout horizontally back, and many extended upward from upper and hind edges of eye, also posteriorly many form into reticulations on back and sides of body and below pectoral. On back at base of dorsal large variable black saddle-like blotch. Black band arches over and along front edge of gill opening back until behind dorsal fin on upper surface of caudal peduncle medially and meets its fellow, but not reaching caudal fin; anteriorly and below it is paler or less contrasted, follows along horizontally close below median axis of body to fade out at bases of infra-median caudal rays. Iris whitish. Fins largely whitish, caudal with rather broad dark to gray-black submarginal band.

TYPE.—A. N. S. P. no. 69850. From stomachs of skipjack and tuna caught off Kaena Point, Oahu. June 20, 1940. Length 43 mm.

Paratypes.—Nos. 69851 to 69890, same data, length 35 to 45 mm. No. 69891, caught with light at night off Diamond Head, September 10, length 35 mm.

Resembles *Canthigaster rivulatus* (Schlegel) but differs in the presence of the large black blotch on the back at the base of the dorsal fin. Jordan and Snyder in 1901 make no mention of such a blotch but state "Dorsal blackish at base, otherwise pale." The nominal *Eumycterias bitaeniatus* Jenkins has an upper black horizontal band, but differently arranged so that it reaches the bases of the upper caudal rays and not passing over the upper surface of the caudal peduncle or meeting its fellow.

(*vāros* back + *απλός* blot.)

## TETRODONTIDAE

*Tetrodon meleagris* Schneider

One, 20 mm., Waianae. Body and head covered all over with rather numerous prickles. Diffused black blotch above each eye. Iris gray. Lips rather dark brown. General color of body brown, back uniform and entire under surface of abdomen with large pearly spots, smaller on under surface of head and before vent. Very minute spots on dorsal whitish, basal region of back dusky. Caudal blackish brown, hind end or edge whitish. Pectoral whitish.

## ANTENNARIIDAE

*Antennarius cunninghami* new species

Figure 32.

Depth  $1\frac{1}{2}$ ; head measured to gill opening  $1\frac{1}{2}$ , width  $1\frac{1}{2}$ . Snout (in profile)  $4\frac{1}{2}$  in head measured from snout tip to pectoral origin, with its front end well below level of eye; eye small, 3 in snout, high, lids not free; maxillary subvertical, length 4 in head measured from snout tip to pectoral origin; lower jaw well projecting in front; teeth villiform, sharp, conic, in broad bands in jaws, also well developed band on each palatine; interorbital width  $3\frac{1}{2}$  in head measured from snout tip to pectoral origin, convexly elevated.

Body all finely spinescent above, rough to touch, prickles largest and best developed on back and dorsal fins. On belly spinules all finely granular.

D. I—I—I—12, bait longer than second dorsal spine, ends in 3 conic tentacles with median shortest and others but little shorter than shaft of spine; sixth dorsal ray longest,  $1\frac{1}{2}$  in head; A. 7, fourth ray  $2\frac{1}{2}$ ; least depth of caudal peduncle  $3\frac{1}{2}$ ; caudal  $1\frac{1}{2}$ , rounded behind; pectoral length 2, rays 9; ventral rays 5, third ray  $2\frac{1}{4}$ .

Color in alcohol yellowish brown above, below light or pale buff yellowish, uniform. Iris brownish, crossed by dark radiating lines. Fins all paler terminally or marginally. Body marked with variable dark gray or brown to blackish streaks. Six blackish lines radiate from eye. On fins many small black spots, most appearing ocellated, largest on anal and paired fins.

TYPE.—A. N. S. P. no. 69892. Oahu or Maui, from fisherman. Length 120 mm.

Only the type obtained. Apparently related to *Antennarius tridens* (Schlegel) and *Antennarius hispidus* (Schneider) as figured by Bleeker, but differing entirely in the structure of the "bait." I have seen no other species of this genus with the above combination of characters.

(For Mr. W. H. Cunningham, who assisted in forming the present collection of fishes.)





# RARE AND EXTINCT BIRDS IN THE COLLECTIONS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA

BY RODOLPHE MEYER DE SCHAUENSEE

*Curator of Birds, The Academy of Natural Sciences of Philadelphia*

## INTRODUCTION

### The Academy's Ornithological Collections

The Academy of Natural Sciences was founded in Philadelphia in 1812<sup>y</sup>. During the earlier period of its 129 years of existence it had exceptional opportunities to secure birds which today have vanished from the earth, forever, or are now so rare or so nearly extinct as to be no longer obtainable on

That the Academy was able to secure so many priceless specimens, the to a great measure, due to the generosity of Dr. Thomas B. Wilson. Song became President of the Academy in 1846, and over a period of s; the purchased for the Academy any important collection on which he thrush, lay his hands. He thus secured the Duc de Rivoli's Collection; the Bo in the Collection of parrots and tanagers; assorted lots of birds from the Verrerie brothers, including some which had belonged to Temminck, d'Orbigny, Stidelattre and others; the Gould Collection of Australian birds; the Bo Indian Collection. By 1860 he had presented to the Academy about 26,000e birds, which added to the Academy's 3,000 skins, made a total of 29,000 specimens.

Among others who added to the Academy's growing collection by gift or purchase were J. J. Audubon, Alexander Wilson, J. K. Townsend, Thomas Nuttall, Paul Du Chaillu, A. L. Heermann, S. W. Woodhouse, John Krider, Elisha Kent Kane, William Gambel, John Cassin and Witmer Stone. In 1857 Dr. P. L. Selater of the Zoological Society of London, said that the Academy's ornithological collection was "superior to that of any museum in Europe and, therefore, is the most perfect in existence" (Proc. Zool. Soc., London, 1857, p. 1). By 1887 the collection numbered 31,550 specimens and by 1899, 42,000. Today it has grown to more than 150,000 skins, which have been collected in every corner of the globe.

Under the proper modern care which these invaluable specimens receive they will last indefinitely. They are kept in light-proof, dust-proof and insect-proof steel cabinets.

It would be surprising to many, for example, to see birds collected by the Pacific Railroad Survey in 1853, by Audubon in the Kikapoo Country on

the Missouri River in 1843, and a hawk (*Falco punctatus*) collected in distant Mauritius in 1832, looking little different from a bird collected yesterday.

At present the Academy is hard at work trying to fill the gaps in its collection, and some expeditions are being made now; others are planned when funds and opportunity present themselves.

#### The Causes of the Extinction of Birds

The number of birds which have become extinct, or nearly so, is alarming and perhaps a paper such as this will make one realize that more stringent steps should be taken to protect birds, especially those restricted to small islands, or those which for some reason or other have a very circumscribed area of distribution. As is evident, these are the ones which have suffered most. In a good many areas the damage already done is irreparable.

Most of the birds which have become extinct within man's memory have disappeared, not so much because they have been "shot off", but because, with the inevitable advance of civilization, the original conditions under which they lived have changed. Sometimes this is unavoidable and other times it is not.

Many birds which have disappeared, as I have said, are those confined to small areas. Unfortunately these species are usually the most highly specialized, and the ones most affected by any change in their natural environment. They are the ones most unsuited to deal with competition from birds or animals imported and liberated in their own surroundings. In addition to the competition for food between native and imported birds, a very serious aspect is the introduction of bird diseases by the introduced species.

In New Zealand, for example, there have been introduced a vast assemblage of foreign birds with the result that today in parts of the country the foreign birds are a great deal commoner than the native ones. Some of the latter have become extinct and many more are on the verge of extinction. Stidolph, on the Wairarapa Plain, New Zealand, in the course of 8 miles counted 275 introduced birds to 2 native ones. (*Emu*, 23, 1923, p. 26.)

The imported birds are, of course, a contributory factor to the disappearance of the native ones. Clearing and burning over of the land for farming, and the importation of both domestic and wild animals, have assisted in the decimation of the native avifauna.

It might be interesting to enumerate the foreign birds which have been brought to New Zealand. They are: Black Swan, Pheasant, California Quail, Rock Pigeon, Greenfinch, Chaffinch, Lesser Redpoll, Goldfinch, English Sparrow, Yellow Hammer, Song Thrush, Black Bird, Hedge Spar-

row, Skylark, Starling and Australian Magpie. These are all generally distributed.

The following have for the present a restricted distribution: Mallard Duck, Canada Goose, Virginia Quail, Australian Quail, Australian Swamp Quail, Little Owl, Cockatoo, Rosella Paroquet, Laughing Kingfisher, Siskin, Linnet, Bullfinch, Cirl Bunting, Indian Mynah, Black-backed Australian Magpie, and Rook. (Stidolph, *Emu*, 33, 1933, p. 93.)

In addition to the above birds the following mammals among others have been introduced: Deer, stoats, ferrets, weasels, rabbits and rats. Sheep and cattle have necessitated the cutting down of large tracts of forest for pasture land, and domestic cats have gone wild and are commonly established in many areas.

In the face of this the native bird population, unable to maintain itself against the invaders and environmental changes, has dwindled alarmingly, and some species have been pushed clear off the mainland to find refuge on some of the small islands off the coast of New Zealand. However, the imported birds are finding their way there too, and now the Goldfinch, Song Thrush, Blackbird, and Starling are established in the Kermadecs; the California Quail, Greenfinch, Goldfinch, English Sparrow, Song Thrush, and Blackbird in the Chatham Islands; the Goldfinch and Blackbird in the Auckland Islands; the Redpoll, Goldfinch, English Sparrow and Starling in the Campbell Islands, and the Goldfinch in the Antipodes Islands. (Stidolph, l. c., p. 93.)

This list is given only as a warning of what may happen when birds are imported and liberated, with the best of intentions, especially on small islands such as Tahiti, and the Hawaiian Islands, where I regret to say it is being done today. The extinction of all birds, however, cannot be blamed solely on these factors.

It must also be remembered that certain species, such as the Chatham Island Rail (*Cabalus*), seemed to have arrived at the end of their evolution and had already begun to disappear before any serious change in their environment took place. Perhaps like the Hawaiian avifauna they had become so overspecialized that they could not keep up with the modern world.

The avifauna of Hawaii has also suffered disastrous results from the importation of birds and their diseases, and the advance of civilization. There too many foreign birds have been liberated, and the mongoose has been imported.

In the United States six birds have become extinct within the last hundred years. This does not include doubtful species, such as Townsend's Dicksissel, etc., named by Audubon. If we except the Great Auk, five have disappeared within the last fifty or sixty years. Others are today

threatened and only by carefully guarding our avifauna will we be able to prevent their extinction.

It seems to be usually thought that shooting is the sole cause of the disappearance of certain birds. That this is partly true is undeniable, but a great many species in our country and Canada are faced with much more serious problems. These are briefly the draining of the marshes, where they breed in the spring, and to which they migrate in the fall; the cutting down of virgin forests, where certain birds find the only possible surroundings in which they can survive, and the inevitable changes in the land which accompany the advance of civilization, such as farming, irrigating, and the populating of areas which once were wild and untouched.

The solution of the problem is a difficult one, but by carefully regulated game laws, and well guarded and judiciously placed state and national refuges, we should be able to maintain our avifauna.

The important thing is to do it before it is too late, for it is a well known fact that when a species becomes reduced to a few individuals nothing that can be done will bring it back.

#### Scope of the Article

The following paper is divided into two sections; extinct and nearly extinct birds in the Academy's collection, and rare birds.

With regard to the former it is impossible to say in many instances that certain birds are definitely extinct, especially those inhabiting huge areas of land such as Australia, where vast sections of the country are scarcely populated or rarely visited. For some years the Turquoise Paroquet (*Neophema pulchella*), the Scarlet-chested Paroquet (*N. splendida*), the Beautiful Paroquet (*N. pulcherrima*) and Orange-breasted Paroquet (*N. chrysogaster*) were all thought to be nearly extinct if not entirely so.

Comparatively recently, however, they have been rediscovered, some of them in parts of the continent in which previously they were thought never to have occurred.

Certain birds which I have placed on the extinct or nearly extinct list may not be so actually, although from the literature they would appear to be. I hope that at least some of them will eventually be found holding their own on remote mountain tops, or in the depths of little frequented forests.

Among the extinct or nearly extinct birds will be found listed 74 species. Of these 27 are considered certainly extinct. They will be found marked with a dagger in the body of the article.

The second part deals with birds which are rare, and by this is meant, rare in collections. Why one bird is rarer than another is unknown. Some-

times it is not really rare at all, but owing to some peculiarity of habits it is difficult to find and to collect; of course, others are just "plain rare", cause unknown.

The choice of birds for this part is a difficult one, and in the Academy's collections are many more which might have been added. However, I have tried to select only those which appeared to have some special interest attached to them.

### The Extinct or Nearly Extinct Birds

#### 1. † GUADALUPE PETREL

*Oceanodroma macrodactyla* Bryant

♀ ; Guadalupe I., May 30, 1906 (J. E. Thayer Coll.)

This petrel was abundant on Guadalupe I., off the west coast of Mexico, in 1892 and common in 1899.

In 1892, however, dozens of dead birds were found killed by feral cats, which had been introduced on the island as well as rats and goats.

When the island was visited in 1922 and again in 1925 none of this petrel was found. Phillips says "The species is now certainly extinct." (Verh. VI Int. Orn. Kongr., Kopenhagen, 1926, p. 504.)

#### 2. HAWAIIAN GOOSE

*Nesochen sandvichensis* (Vigors)

o; Sandwich Islands (Rivoli Coll.)

o; no data.

When Delacour visited Hawaii in about 1927, Robert Hind told him that the only important flock of Hawaiian Geese left was to be found on his ranch, Puuwaawaa. Thirty years before the birds had been very abundant. Outside of the ranch property they were very scarce, and only couples were to be seen here and there. The mongoose is the chief enemy of the goose, for it not only kills the goslings, but eats the eggs as well. (Delacour, Ois., 9, 1928, p. 212.)

Recorded as rare by Baldwin who has seen about a dozen individuals recently on Mauna Loa (Natl. Park Service Pub., Jan. 1941).

#### 3. BROWN DUCK

*Anas chlorotis* G. R. Gray

o; New Zealand (Rivoli Coll.)

This duck, due to the draining of swamps and the trampling of the ground by cattle, is today nearly extinct in New Zealand. (Stidolph, Emu, 33, 1933, p. 11.)

It once occurred on Chatham I., but became extinct there in 1915. (Fleming, Emu, 38, 1939, p. 389.)

4. † LABRADOR DUCK

*Camptorhynchus labradorius* (Gmelin)

♂ ad.; no data. (Carpenter Coll.)

2 ♂ imm.; no data.

♀ ad.; no data.

The last known specimen of this sea duck was shot off Long Island in 1875. Never a common duck, the cause of its extinction is unknown. Though not considered particularly good for the table, many appeared in the markets of Philadelphia, New York, and Boston.

It was said to breed in Labrador, migrating in winter to New England and New Jersey waters. According to Audubon "It also at times enters the Delaware River, in Pennsylvania, and ascends that stream at least as far as Philadelphia." (Orn. Biog., 4, 1838, p. 271.)

About 50 specimens are known to have been preserved.

5. CUBAN SNAIL HAWK

*Chondrohierax wilsonii* (Cassin)

♂, ♀; Gibara, northeast Cuba, about 1846 (Richard C. Taylor Coll.) (♂ = Type).\*

This curious hawk is on the verge of extinction. It was last seen in woods south of Guantanamo in about 1920 (Bond, Check-list Bds. W. Ind., 1940, p. 21).

Richard C. Taylor, a member of the Academy, remarked at the time he collected the birds that "A resident of the island (Cuba) assured me they were extremely rare" (Proc. Acad. Nat. Sci., Phila., 3, 1847, p. 200).

6. CALIFORNIA CONDOR

*Gymnogyps californianus* (Shaw)

o; California (no further data).

o; Philadelphia Zoological Society, September 1898.

2 o; no data.

As all vultures, this is an eater of carrion, and in the case of this one the habit has been its undoing. When poisoned bait was put out for wolves, mountain lions, bears and other predators, the keen-eyed condor often spied it first.

The condor still exists in California but in such reduced numbers that unless carefully protected it is likely to disappear altogether. Phillips in

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\* Birds marked "Type" are those so listed by Stone in his paper on the types in the Academy's collections. (Proc. Acad. Nat. Sci. Phila., 1899, pp. 5-62.)

1926 thought that 75 pairs was a fair estimate of the number surviving then; fifty pairs in California and twenty-five in Mexico's Lower California peninsula. (Verh. VI Int. Orn. Kongr., Kopenhagen, 1926, p. 506.)

The 1940 report of the Committee on Bird Protection of the American Ornithologists' Union states that this magnificent bird survives only on United States territory. From the total of about 150 birds reported by Phillips in 1926, only about one-third survives.

Of the California Condor the above mentioned committee says: "Its range and numbers are so limited that they are now leading definitely to extermination" (Auk, 58, 1941, p. 293).

Of course shooting has been another of the major causes of the decimation of this bird, but now it is on the protected list. W. L. Dawson says that the "forty-niners" shot numbers of these birds as they found that "the great wing quills of the Condor made convenient receptacles for carrying gold dust" (The Birds of Calif., 4, 1923, p. 1734).

#### 7. † HEATH HEN

*Tympanuchus cupido cupido* (Linnaeus)

♂ ; Philadelphia market, 1872 (N. T. Lawrence Coll.)

♂ ; New Jersey, about 1880 (purchased from a farmer)

♂ ; Philadelphia market, 1884 (W. L. Bailey Coll.)

♂ ; Martha's Vineyard, Mass., Dec. 29, 1886 ("crop full of acorns of scrub oak") (Kennard Coll.)

♂ ; Burlington Co., New Jersey, about 1887 (S. Ellis Howard Coll.)

2♂, 4♀, 2o; Martha's Vineyard, Mass., 1896-98 (Kennard Coll.)

♀ ; no data (N. T. Lawrence Coll.)

This game bird, once distributed throughout the brush country of the eastern seaboard, made its last stand on Martha's Vineyard, Massachusetts and finally disappeared in 1932.

According to Audubon it had nearly vanished from New Jersey by 1834, where it was much hunted.

Writing of the Heath Hen in 1834, he said "The sportsman of the eastern states now makes much ado to procure them, and will travel . . . a hundred miles or more to shoot at most a dozen brace in a fortnight; . . . So rare have they become in the markets of Philadelphia, New York and Boston that they sell at from five to ten dollars the pair. An excellent friend of mine told me that he refused 100 dollars for ten brace, which he had shot on the Pocano mountains of Pennsylvania." (Orn. Biog., 2, 1834, p. 492.)

In Audubon's days, although rare, the Heath Hen was still found in parts of New Jersey, Long Island, Martha's Vineyard, and on Mount Desert Island.



The decline in Martha's Vineyard started with the very serious brush fire of 1916. Before the fire their number was estimated at 800 to 2,000, after it at 150. (Phillips, Verh. VI Int. Orn. Kongr., Kopenhagen, 1926, p. 507.)

There are over 200 specimens preserved in collections.

The present day Prairie Chicken (*T. c. pinnatus*) is almost indistinguishable from its extinct cousin.

#### 8. † NEW ZEALAND QUAIL

*Coturnix novaezealandiae* Quoy and Gaimard

♂ ; " Nouvelle Zeland " 1846 (Verreaux Frères)

♂ ; no data

♀ ; Port Cooper, New Zealand (no date)

A correspondent, not named, writing to Sir Walter Buller prior to 1888, had this to say regarding the New Zealand Quail. " It cannot be said, as in other cases, that this species was exterminated by the introduction of other birds into its natural habitat, because it had almost disappeared before any acclimatized birds had reached the grass-covered downs where formerly it was so abundant. The tussock fires have been the prime cause of the annihilation of this useful bird by destroying the seeds and insects on which it subsisted. So far as I have been able to discover the last specimen seen alive was on the Raincliffe Station, in the year 1878."

Oliver says that the last specimens were shot at Blueskin Bay in 1867 or 1868 and were acquired by Sir Walter Buller. (New Zeal. Bds., 1930, p. 375.)

Stidolph in his careful survey of New Zealand birds records the New Zealand Quail as extinct. (Emu, 33, 1933, p. 11.)

Our Verreaux specimens probably were secured by him in 1846, and formed part of the series to which two specimens in the Paris Museum belong. (Berlioz, Arch. Mus. d'Hist. Nat., Paris, 12, 1935, p. 488.)

#### 9. WHOOPING CRANE

*Grus americana* (Linnaeus)

o; Philadelphia Zoological Society, Jan. 1892.

o; downy young, Winnebago Co., Iowa, 1879 (W. L. Abbott Coll.)

About 100 individuals of this magnificent snow-white crane are left today. Since 1880 it has been a rare bird.

The species has been reduced to such a low number that it is in great danger of disappearing altogether.

Although a very wary bird, Audubon once succeeded in shooting seven with one shot!

In Catesby's day an Indian told him that "great multitudes of them frequent the lower parts of the Rivers near the Sea" (Nat. Hist. of Carolina, etc. 1, 1731, p. 75).

10. † CHATHAM ISLAND RAIL

*Cabalus modestus* (Hutton)

♂ ; Chatham Is. (Hutton Coll.)

This semi-nocturnal, flightless rail once inhabited the Chatham Islands off New Zealand, but when discovered in 1871 it was confined to Mangare I. Its extermination was due to the burning-off of the original vegetation so that grass could grow for sheep-farming. Introduced cats and rats hastened its disappearance. It still existed in 1893, but finally vanished completely in about 1900. (Bds. Chath. Is., Fleming, Emu, 38, 1939, p. 389.)

It was a very primitive bird which was probably disappearing from natural causes when discovered. The fact that it had become extinct on Chatham I. rather points to this fact.

An early account of the birds of the Chatham Islands was written by H. O. Forbes in 1893 (Ibis, p. 521), and an earlier one by Hutton in 1872. (Ibis, p. 243.)

10A. † JAMAICA BLACK RAIL

*Laterallus jamaicensis jamaicensis* (Gmelin)

♂ ; Jamaica, no further data.

This tiny rail has apparently been extinct for many years, probably exterminated by the introduced mongoose.

March (Proc. Acad. Nat. Sci. Phila., 16, 1864, p. 69) stated "The Little Black Rail, is . . . of frequent occurrence about marshy lands. . . ."

Stuart Panton, of Jamaica, remembers this bird as an inhabitant of up-land pastures about forty years ago in the vicinity of Mandeville (Bond).

11. SAND PLOVER

*Thinornis novae-seelandiae* (Gmelin)

♂ ; New Zealand, 1846 (Verreaux Coll.)

2 ♀ ; Chatham Is., Jan. 1892 (H. O. Forbes, Tristram Coll.)

This plover, first reported by Captain Cook's expedition in 1773, was once moderately plentiful on both North and South Islands and some of the outlying islands off New Zealand. With the settlement of the mainland it disappeared and is now found only on certain islets of the Chatham group (Oliver, New Zeal. Bds., 1930, p. 289).

Noted as almost extinct by Stidolph (Emu, 33, 1933, p. 11).

Fleming estimated their number at 70 pairs (Emu, 39, 1939, p. 12). He found the Sand Plover only on South East I., 540 acres in extent, to which it is now apparently confined.

## 12. ESKIMO CURLEW

*Numenius borealis* (Forster)

o; McKenzie R., Arctic America, June 1864 (McFarlan Coll.)

2 o; no data.

♂; mounted, no data.

o; no data (Woolman Coll.)

o; no data (Tristram Coll.)

o; no data (Krider Coll.)

If not already extinct the Eskimo Curlew is so nearly so that it deserves a place on this list.

Recorded last in 1939, when a winter migrant was reported from eastern Buenos Aires Prov., Argentina, by Runacles (Wetmore, Auk, 1939, p. 475). This was a sight record. The last specimen known to have been shot, was killed in Argentina on January 11, 1925.

Many years ago these birds were considered a delicacy, and when numbers were shot during the autumn migration, they were salted and eaten during the winter. This was especially the case after the disappearance of the Passenger Pigeon.

The Eskimo Curlew nested in Arctic America and migrated to Argentina and Patagonia.

With regard to this species Audubon makes the following interesting remarks. "... They become fat so as to afford excellent eating, in consequence of which they have probably acquired the name of 'Doughbird' ... They ... arrived in such dense flocks as to remind me of the Passenger Pigeons ... The appearance of man did not seem to intimidate them, for they would alight so near us, ... that we easily shot them. ... Those we procured were extremely fat and juicy especially the young birds, of which we ate a good many. Dr. Jones, an old settler of Bras d'Or (Labrador), and his son shot a great number every season, which they salted for winter food." (Orn. Biog., 3, 1885, pp. 69-71.)

W. H. Hudson says that in 1877 and 1880 large flocks were seen in Argentina and it "was common enough ... on the pampas in my day." (Birds of La Plata, 2, p. 208, 1920.)

## 13. CHATHAM ISLAND SNIPE

*Coenocorypha auklandica pusilla* (Buller)

2 o; Chatham Is., Jan. 1892 (H. O. Forbes, Tristram Coll.)

This nocturnal snipe is today confined to the 540 acres which compose South East Island of the Chatham group. Fortunately it is not rare there.

"There appears to be no introduced predatory check on its multiplication and the dread possibility of pests reaching South East Island is the only factor which jeopardizes its future existence." (Fleming, Emu, 38, 1939, p. 497.)

14. † GREAT AUK

*Pinguinus impennis* (Linnaeus)

o; no data (mounted) (Rivoli Coll.)

This large flightless bird was exterminated on the European side of the Atlantic in 1844, and on the American side some years later.

The birds nested in great colonies which were raided by fishermen who slaughtered them in great numbers. Oil was made from their bodies, and their flesh was used as bait.

Audubon never saw this bird alive and it must have been very scarce previous to 1838, for in his Ornithological Biography, published in that year, he says "The only authentic account of the occurrence of this bird on our coast that I possess was obtained from Dr. Henry Havell . . . who when on his passage from New York to England, hooked a Great Auk on the banks of Newfoundland, in extremely boisterous weather."

Further "An old gunner residing on Chelsea Beach, near Boston, told me that he well remembered the time when the Penguins were plentiful about Nahant and some other islands in the bay." (Orn. Biog., 4, 1838, p. 316.)

The Great Auk ranged in historic times from Greenland south to Massachusetts, as well as to Iceland, the Faroe and Orkney Islands, St. Kilda, Skye and northern Ireland. Bones have been found as far south as Florida, and in continental Europe, showing a greater range in prehistoric times.

Between 70 and 80 specimens are to be found in museums.

An egg of the Great Auk is preserved in the Academy's collection. A contributory cause to the extinction of this interesting flightless bird was the wholesale collection of their eggs for food by early voyagers and fishermen.

Sixty to seventy eggs are known to have been preserved (Phillips, Verh. VI Int. Orn. Kongr., Copenhagen, 1926, p. 503).

A skull of the Great Auk was added to our collection in 1914.

15. † NORFOLK ISLAND PIGEON

*Hemiphaga novaeseelandiae spadicea* (Latham)

o; Norfolk I. (Gould Coll.)

The Norfolk Island Pigeon was first described in 1802 and survived its discovery less than 100 years.

I can find no reference as to the exact date of its extinction, but Salvadori, writing in 1893, said that it was then probably extinct. Nineteen examples have been preserved.

According to Iredale this pigeon occurred on Lord Howe I., as well as on Norfolk (Proc. Linn. Soc. N. S. Wales, 35, 1910, p. 781).

#### 16. † PASSENGER PIGEON

*Ectopistes migratoria* (Linnaeus)

♂ imm.; Carlisle, Pa., Oct. 19, 1844 (Spencer F. Baird Coll.)

♂; near Baltimore, Md., 1860 (Tristram Coll.)

♂; East Hatboro, Chester Co., Pa., 1870 (Pennock Coll.)

♂, ♀; Lancaster Co., Pa., 1875 (Pennock Coll.)

♀; Philadelphia, Pa., Nov. 12, 1877 (W. L. Abbott Coll.)

2♂, ♀; Philadelphia market, Dec. 13, 1877 (W. L. Abbott Coll.)

♂; Haddonfield, N. J., 1879 (W. L. Abbott Coll.)

♀; Mitchell Co., Iowa, Sept. 7, 1879 (W. L. Abbott Coll.)

♂; near Holland, Ottawa Co., Mich., 1894 (Sharpless Coll.)

♂, ♀, ♀ imm.; "Pennsylvania", Nov. 28, 1898 (H. W. Fowler Coll.)

25 specimens with no data.

The Passenger Pigeon was probably the most numerous bird in America 75 years ago, and it seems impossible that not a single individual remains alive today.

Catesby said that "in their passage the people of New York and Philadelphia shoot many of them as they fly, from their balconies and tops of houses" (Nat. Hist. Carolina, etc., 1731, p. 23).

Audubon described immense flocks which took three days to pass a given point and said of them: "The light of noon-day was obscured as by an eclipse. The continued buzzing of wings had a tendency to lull my senses to repose."

Alexander Wilson estimated the number of birds in a flock which he saw in 1808 as 2,232,270,000.

Countless millions of birds were slaughtered for food, fertilizer and hog feed until not one individual survived. In 1805 pigeons sold in New York for a cent each.

From a single nesting ground in Michigan five carloads of pigeons were shipped to market for thirty consecutive days; 8250 dozen to a carload or a total of 14,850,000 birds. This was in 1870.

The last specimen to be shot was one in Connecticut in 1906.

"On Sept. 1, 1914, at 9:32 A.M. (Central Standard Time) in the Cincinnati Zoo died the last passenger pigeon on earth" (Time, 37, no. 11, 1941, p. 60).

## 17. † NORFOLK ISLAND PARROT

*Nestor productus* Gould

o; Phillip Island (Gould Coll.) (= Type)

About 15 specimens of this fine parrot have been preserved. It lived on Norfolk and Phillip Is., both between Australia and New Zealand.

The bird was very tame, and as it flew but little, could be easily caught. It first disappeared from Norfolk I., and was finally exterminated on Phillip I., a penal colony, when supplies for the convicts were delayed, and all of the birds were killed for food (Ashby, *Emu*, 23, 1934, p. 178). I have been unable to ascertain the exact date but it must have been toward the middle of the last century.

## 18. † CAROLINA PAROQUET

*Conuropsis carolinensis carolinensis* (Linnaeus)

♂, 2 ♀; Thonotassa, Fla., April 25, 1887 (Hasbrough Coll.)

♂, ♀; Osceola, Fla., March 18, 19, 1896 (E. J. Brown Coll.)

♂; Johnson Island, Osceola, Fla., March 15, 1897 (Pennock Coll.)

o; no locality (Bourcier Coll.)

2 flat skins, no data (from plume dealers)

o; no data (Hoopes and Turnbull Coll.)

2 ♀; Philadelphia Zoological Society, Aug. 1898.

This parrot and its western representative were the only parrots to be found commonly in the United States.

The last birds to be seen alive were a small flock in Florida in 1904.

Destructive to fruit, they were continually shot and were further helped along the road to extinction by plume collectors, bird catchers, and "sportsmen."

Writing in 1831, Audubon said that the Carolina Paroquet "eats or destroys almost every kind of fruit indiscriminately, and on this account is always an unwelcome visitor to the planter, the farmer and the gardener. . . . Do not imagine, reader, that all these outrages are borne without severe retaliation on the part of the planters. . . . The Parakeets are destroyed in great numbers . . . the gun is kept at work; eight or ten or even twenty are killed at every discharge.

"The living birds . . . return to the stack to be shot at, until so few remain alive that the farmer does not consider it worth his while to spend more of his ammunition. I have seen several hundred destroyed in this manner in the course of a few hours, and have procured a basketful of these birds at a few shots, in order to make choice of good specimens for drawing. . . ." (*Orn. Biog.*, 1, 1831, p. 136.)

This bird ranged commonly from Virginia to Florida and occasionally north to Pennsylvania and New York.

Persistent reports appear from time to time of the survival of the Carolina Paroquet in the Santee Swamp in South Carolina. The most recent such report appeared in "Time" during August, but the record was due to a misunderstanding.

Mr. E. Milby Burton, director of the Charleston Museum, in answer to enquiries regarding the above report says that "the Parrakeet may be regarded as an extinct species."

The last known living specimen was a cage bird, owned by Dr. Ridgway of the United States National Museum, which died in 1914.

#### 19. † WESTERN CAROLINA PAROQUET

*Conuropsis carolinensis ludovicianus* (Gmelin)

♂ ; Bald Island, Upper Missouri, April 25, 1855 (Expl. Upper Missouri and Yellowstone, Lt. G. K. Warren U. S. A., and Dr. L. V. Hayden)

5 o; Kickapoo Country, vicinity of Fort Leavenworth, Missouri River, May 4, 1843 (Audubon and Harris Coll.) presented by Fletcher Street.

♀ ; Texas (Rivoli Coll.)

This western subspecies was found in the interior of the United States, north to southern Wisconsin and western New York, west to Colorado and Oklahoma and south to the Gulf of Mexico.

It probably became extinct somewhat before the eastern form.

Of this bird Audubon said "At the present day very few are to be found higher than Cincinnati, nor is it until you reach the mouth of the Ohio that Parakeets are met with in considerable numbers. I should think that along the Mississippi River there are not now half the number that existed fifteen years ago." (Orn. Biog., 1, p. 138, 1831).

#### 20. TRES MARIAS PARROTLET

*Forpus cyanopygius insularis* (Ridgway)

Collected by the George Vanderbilt Expedition 1941—Specimens not yet at the Academy.

On Maria Madre the California Academy of Sciences Expedition (1925) found the Tres Marias Parrotlet "not very common", and saw no specimens of it on Maria Magdalena (McLellan, Proc. Cal. Acad. Sci., 15, 1926, p. 300).

In another report (1927) on a collection from the islands, the species is not mentioned. (l. c., 16, 1927.)

During George Vanderbilt's stay on Maria Madre, Tres Marias Islands, off the west coast of Mexico (July 1941) a few specimens of this little

parrotlet were secured. Dawson A. Feathers, Vanderbilt's collector, writes me that but one flock, composed of a dozen individuals was seen. They were found in the interior of the island where a patch of virgin forest, "what might be called semi-rain forests", survives.

The expedition looked carefully for evidence of other flocks or individuals in this and other areas, but no others were seen.

The natives of the island did not know the bird, even by name, but knew the Amazon Parrot (*Amazona ochrocephala tresmariae*) which they believed to be the only parrot on the island.

While Vanderbilt's expedition did not stay long enough to investigate fully the status of this bird, on account of its apparent rarity, it seems worth while to record their observations.

## 21. PUERTO RICAN PARROT

*Amazona vittata vittata* (Boddaert)

2 ♂; Puerto Rico (Rivoli Coll.)

This parrot was once common on Puerto Rico, but in late years it has become very rare and is apparently now disappearing rapidly.

Its history for the last thirty years is as follows: In 1912 it was restricted to three or four localities on the island. In 1931 Danforth found it only in the forests on the Sierra Luquillo, where it was seen again by Wetmore in 1937. (Bond, Check-list Bds. W. Ind., p. 60.)

The disappearance of this parrot is due to the felling of the forests for sugar and coffee plantations, and to the fact that it is hunted for food by the natives.

## 22. CHILEAN PAROQUET

*Cyanoliseus patagonus byroni* (J. E. Gray)

♂, ♀; Chile (Rivoli Coll.)

This beautiful and unusually colored paroquet was once common in Chile. In 1852 it was one of the commonest birds in the central provinces. In 1894 it was reported as becoming rare and from 1905 onward its numbers dwindled rapidly. No specimen of it was seen by the Field Museum Expedition to Chile in 1922-24.

"The ruthless persecution by the plantation owners and the destruction of the young birds used for food are no doubt responsible for the disappearance of this fine Paroquet, and unless serious protective measures are taken, we may soon have to include it in the ever growing list of extinct species." (Hellmayr, Field Mus. Nat. Hist. Pub., Zoology, 19, 1932, p. 257.)

The same author says "Barros thinks that the 'loro' may still exist in small numbers in the Cordillera near Rancagua, O'Higgins . . . Mr. San-



born . . . was told that a small breeding colony survived in the cliffs near Domeyko, south of Vallenar " (l. c., p. 257).

There is a reference to this species (Rev. Chil. Hist. Nat., 38, 1934), but the publication is not available.

### 23. MASKED PARROT

*Pyrrhulopsis personatus* (Gray)

♀ ; Viti-levu, Fiji, Aug. 18, 1881 (Ainsdell Coll.)

♀ ; Viti-levu, Fiji, July 25, 1937 (S. D. Ripley Coll.)

This large and handsome parrot is peculiar to Viti-levu of the Fiji group, from where it is said to be fast disappearing. Of it Dr. Bahr says " Of the rarer birds peculiar to Fiji this will be the first to become extinct at no very distant date." (Ibis, 1912, p. 293.)

Wood and Wetmore consider this species doomed (Ibis, 1926, p. 92).

The Masked Parrot is sorely threatened by the mongoose, and by planters, for it is destructive to fruit.

Dillon Ripley, who collected one of the above specimens, informs me that it was the only bird he saw. Dr. A. H. Martin, a resident of Fiji, told Ripley that the parrot was very scarce.

### 24. † MACQUARIE ISLAND PAROQUET

*Cyanoramphus novaezelandiae erythrotis* (Wagler)

o; no data (Gould Coll.)

This green and red paroquet lived only on Macquarie Island in the Pacific 900 miles south of Tasmania. It became extinct between 1890 and 1900.

The rail (*Rallus phillippensis macquariensis* Hutton) the only other indigenous land bird became extinct at about the same time. (Crowther and Falla, Emu, 33, 1933, p. 16.)

The rail, when first discovered by a sealing expedition in 1879, was said to be common on the south part of the island, but difficult to catch (Hutton, Ibis, 1879, p. 454.)

### 25. WHITE-BREASTED COUA

*Coua delalandei* (Temminck)

♂ ; Madagascar (Rivoli Coll.)

No living specimen of this large cuckoo has been seen for over 100 years. The joint expedition of the Paris, British, and New York natural history museums to Madagascar failed to find it when collecting there in 1929. Greenway, a member of the expedition, informs me that it was not looked for in the large Sianaka forest, from whence the few known specimens are said to have come. There are but seven specimens of it preserved.

A. L. Rand, who was in Madagascar with the expedition mentioned above, says "Lauvaden is of the opinion that this bird is not extinct, but it seems strange that if this is so, such a large bird of the forest floor has not been taken by native hunters in recent years. Probably it is extinct" (Bull. Amer. Mus. Nat. Hist., 73, 1936, p. 411).

The two specimens in Paris were collected in 1820 and 1834, the first by Delalande, the second by Bernier. The bird inhabited the Ile Sainte Marie, a few miles off the east coast of Madagascar, as well as the opposite mainland.

#### 26. PUERTO RICAN SHORT-EARED OWL

*Asio flammeus portoricensis* Ridgway

♀ ; La Parquera, southwestern Puerto Rico, 1930 (Mario Agrait Coll.)

On the verge of extinction, the last specimen was taken at Añasco in 1936. (Bond, Check-list Bds. W. Ind., 1940, p. 70.)

#### 27. NEWTON'S OWL

*Otus nudipes newtoni* (Lawrence)

2 ♀ ; St. Thomas (R. Swift Coll.)

♀ ; St. Croix, 1940 (Beatty Coll.)

At one time found widely in the Virgin Islands. Now confined to St. Croix, where it was rediscovered in 1936 (l. c., p. 68).

#### 28. † GUADALUPE FLICKER

*Colaptes cafer rufipileus* (Ridgway)

♂ , ♀ ; Guadalupe I., May 6, 18, 1906 (J. E. Thayer Coll.)

In 1887 this bird must have been reasonably common for at that time a number of examples were secured which later were destroyed by fire. In 1906 their number on the island was calculated at only 40 specimens. Between then and 1922 they vanished, for none was seen in that year by an expedition which visited Guadalupe I., nor in 1925 when the island was re-visited.

Phillips says unqualifiedly that it is extinct (Verh. VI Int. Orn. Kongr., Copenhagen, 1926, p. 513).

The Vanderbilt Expedition (July 1941) did not see any evidence of the bird.

#### 29. IVORY-BILLED WOODPECKER

*Campephilus principalis principalis* (Linnaeus)

♀ ; Tarpon Springs, Fla., April 7, 1889 (Hoopes Coll.)

♀ ; Myers, Fla., 1891 (Rhoades Coll.)

- ♂ ; Bolivar Co., Miss., March 1893 (Hoopes Coll.)  
♀ ; Waucissa River, Fla., Feb. 21, 1894 (Sharpless Coll.)  
♂ ; Waucissa River, Fla., April 11, 1894 (Sharpless Coll.)  
♂ ; St. Marks, Fla., 1901 (Pennock Coll.)  
♂ ; Stephenville, Taylor Co., Fla., Jan. 3, 1901 (Pennock Coll.)  
♀ ; Aucilla River, Fla., May 30, 1917 (Pennock Coll.)  
♀ ; no data (Tristram Coll.)  
2 ♀ ; no data (Hoopes and Turnbull Coll.)  
♂ ; no data (Dr. Woodhouse Coll.)  
♂ ; no data (Rivoli Coll.)  
2 ♂, 2 ♀ ; no data.

The Ivory-billed Woodpecker has apparently been much hunted since earliest times. Catesby, writing in 1731, said that the southern Indians traded the bills of these birds with the northern Indians and received "two and sometimes three Buckskins a Bill." (Nat. Hist. Carolina, etc., 1, p. 16.)

Audubon, in 1831 wrote: "They [Ivory-billed Woodpeckers] are heard at a considerable distance . . . [and] so frequently . . . [that] this circumstance leads to their destruction, which is aimed at, not because (as is supposed by some) this species is a destroyer of trees, but more because it is a beautiful bird, and its rich scalp attached to the upper mandible . . . forms an ornament for the war dress of most of our Indians, or for the shot-pouch of our squatters and hunters, by all of whom the bird is shot merely for that purpose. Travelers of all nations are also fond of possessing the upper parts of the head and the bill of the male, and . . . on a steamboat reaching what we call a *wooding place* the *strangers* were very apt to pay a quarter of a dollar for two or three heads of this Woodpecker." (Orn. Biog., 1, 1831, p. 343.) In Florida the bird was hunted for food, and considered by some as superior to wild duck!

This species survived in numbers as long as the primeval forest did. When it went the bird went with it. Today in patches of undisturbed swampy woods about 24 birds are said to exist, in Louisiana, Florida and the Santee Swamp in South Carolina (Tanner, Aud. Mag., 43, 1941, p. 8).

Mr. J. T. Sackett of the staff of this museum, and Mr. C. H. Judd, believe they saw Ivory-billed Woodpeckers in Florida during the spring of this year. The first one seen was a female at Deep Lake, Collier County, Florida, in Big Cypress Swamp. The bird was observed at no more than 35 feet. The date was May 9. Another female was thought to have been seen twelve miles southwest of Homestead, Dade County, Florida on May 13. This bird was observed at a distance of approximately 45 feet.

Formerly the Ivory-bill was found in the valleys of the Mississippi and Ohio Rivers north to Illinois and Indiana, and parts of Kentucky and Tennessee. Its chance of surviving is slim.

## 30. CUBAN IVORY-BILLED WOODPECKER

*Campephilus principalis bairdii* Cassin

♂, ♀; Cuba, about 1846 (R. C. Taylor Coll.) (♂ = Type).

Once wide-spread in Cuba, the Cuban Ivory-bill was last collected at San Luis de la Cabezada in 1907. It was seen in about 1920 in the Sierra del Cristal. If it still exists it must be confined to this range. (Bond, Check-list Bds. W. Ind., 1940, p. 86.)

## 31. †STEPHEN ISLAND WREN

*Traversia lyalli* Rothschild

♀; Stephen Island, New Zealand, 1894 (Dr. Lyall Coll.)

This semi-nocturnal "wren"-like bird inhabited Stephen Island, a small, rocky but partly wooded islet about a quarter of a mile in area. It is situated in Cook Strait, between North and South Islands of New Zealand. The bird's brief history is extraordinary. It is entirely a story of "what the cat brought in."

In 1894, through Henry H. Travers, Lord Rothschild received the first specimen of this bird. It had been brought in by the cat belonging to Dr. Lyall R. N., the light-house keeper on Stephen Island.

The cat in a very short time brought in a total of about a dozen specimens which were recovered by Dr. Lyall and found their way to museums. How many others it quietly ate will never be known. The cat had the unique distinction of discovering the Island Wren, and the appetite to exterminate it.

## 32. NORTHERN LYRE-BIRD

*Menura alberti* Bonaparte

♂; East Australia (Gould Coll.)

♀; Australia (Rivoli Coll.)

This large bird apparently had not been seen for sixty years when Mathews wrote *The Birds of Australia*.

It was known from the Richmond River district and southern Queensland. Mathews says of it "it is now (1919) approaching extinction, if this be not already achieved." (Bds. Aust., 7, p. 410.)

In a letter from Kinghorn to Greenway the former says that although not extinct it is very rare and local.

## 33. NOISY SCRUB BIRD

*Atrichornis clamosa* (Gould)

♂; West Australia, 1839-43 (Gould Coll.) (A.N.S.P. no. 17692 = Type)

♀ imm.; King Georges Sound (Gould Coll.)

♂ ; King Georges Sound (Gould Coll.)

♂ ; Australia (Rivoli Coll.)

Our female is apparently the only one in existence.

This bird, which was confined to South-west Australia, according to Mathews "has become entirely extinct."

It was last recorded from near Albany, and in 1897 a nest supposed to belong to this species was collected there and a female seen (Mathews, *Birds Aust.*, 8, p. 30, 1919-20) (Le Soëf, *Ibis*, 1900, p. 462).

Campbell says that "in 1912 S. W. Jackson visited the same district—Tor Bay and Denmark, southwest Australia . . . but found no sign of the Noisy Scrub-bird. It is a melancholy tale. He met with cats gone wild everywhere, and frequently caught them in traps.

"During daily rambles he came across numerous bundles of feathers of Brush Bronzewing Pigeons, White-browed Babblers, Rufous Whistlers, Bronze Cuckoos, Pied Grallinas, Rufous Tree-creepers, Sitellas, Flycatchers and others.

"The species is now, 76 years after discovery, marked apparently extinct.

"Regarding the birds themselves, a list should be made recording the known skins." (Emu, 38, 1939, p. 356.)

Campbell lists the following skins: Two in the National Museum, Melbourne, in alcohol, collected in 1889; two mounted birds, one of which was collected in 1890.

Two in the British Museum.

A sternum in the Royal College of Surgeons.

In United States museums are the following specimens:

In the American Museum of Natural History, New York:

♂; Type of *A. c. campbelli* (Mathews), King Georges Sound (Bull. Brit. Orn. Cl., 36, 1906, p. 83). A synonym of *A. clamosa*.

In the United States National Museum:

♂, "N.S.W."

In the Museum of Comparative Zoölogy, Cambridge, Mass.:

♂, no data (Lafresnaye Coll.)

Apparently these and the Academy's specimens are the only ones in America.

I do not know what specimens are in continental European museums and at present it is not possible to find out, but Major H. M. Whittell tells me (in lit. July 29, 1941) that as far as he can ascertain there are 19 specimens preserved.

Major Whittell, Secretary of the Royal Australian Ornithologists' Union, writes me that he has gathered all the available information on this rare and curious bird which he will publish shortly.

**34. BLACK-THROATED COACH-WHIP BIRD***Psophodes nigrogularis nigrogularis* Gould

♂ ; West Australia (Gould Coll.) (Type)

♂ ; Australia (Gould Coll.)

Imm.; West Australia (Gould Coll.)

For many years this bird was supposed to be extinct but it was re-discovered on July 30, 1939, when Major H. M. Whittell, Dr. Edward Watts, and his son Ted Watts, secured a specimen at Gnowangerup, West Australia.

This bird was the first seen since the late A. W. Milligan secured two specimens on the Margaret River in 1901. (Whittell, *Emu*, 39, 1939, p. 129.)

A new race of this bird was described in 1932, and is said to differ by its paler color. A good account of it is given by McGilp and Parsans (*South Austr. Orn.*, 14, 1937, p. 3; *l. c.*, 15, 1939, pp. 2, 19). It is a very rare bird and other accounts of it can be found in the *Emu* (32, 1933, p. 133) by Howe and Ross.

**35. MAURITIUS BULBUL***Ixocincla borbonica olivacea* (Jard. & Selb.)

o; no data (Rivoli Coll.)

A Mauritius species which is rapidly becoming extinct, and when last reported was confined to the southwest part of the island. When plentiful it was considered a delicacy. (Minertzhagen, *Ibis*, 1912, p. 87.)

**36. ST. VINCENT WREN***Troglodytes musculus musicus* (Lawrence)

♂ ; St. Vincent, June 21, 1929 (James Bond Coll.)

Formerly common and wide-spread but now very rare and local. (Bond, *Check-list Bds. W. Ind.*, 1940, p. 101.)

**37. † GUADELOUPE WREN***Troglodytes musculus guadeloupensis* (Cory)

♂ ; Guadeloupe, Feb. 15, 1902 (Native Coll.)

This wren is now probably extinct. It was last taken in 1914 at Sainte Rose (Bond, *l. c.*, p. 101).

It was not rare in 1902 (Phillips, *Verh. VI Int. Orn. Kongr.*, Copenhagen, 1926, p. 530).

Danforth says that it is "now probably extinct." It was last taken in woods which have been since cut down. (*Journ. Agr. Univ. Puerto Rico*, 23, 1939, p. 35.)

## 38. ST. LUCIA WREN

*Troglodytes musculus mesoleucus* (Sclater)

2 ♂ ; St. Lucia, May 6, 1929 (James Bond Coll.)

This wren was once common on the island. In 1927 it was found at Le Marquis and Grande Anse on the windward coast, but it was rare.

In 1934 and again in 1938 it was looked for at those localities and not found (Bond, l. c., p. 101).

## 39. † MARTINIQUE WREN

*Troglodytes musculus martinicensis* (Sclater)

♂ ; Martinique, Nov. 2, 1886 (W. E. Richardson Coll.)

This bird was still fairly common in 1878, but disappeared rapidly. Apparently the last birds taken were those by Richardson in 1886. Since then there has been no news of it.

The rapid decimation of the above four West Indian wrens is due to the introduction of the mongoose, which was brought originally to kill rats and snakes.

## 40. † WHITE-BREASTED THRASHER

*Ramphocinclus brachyurus brachyurus* (Vieillot)

♂ ; no data (Cassin Coll.)

♂, o; no data (Rivoli Coll.)

Many years ago this bird was common on Martinique. It was last collected in 1878, and since then nothing further has been heard of it. It can safely be assumed to be extinct. The older natives remember the bird. (Bond, Check-list Bds. W. Ind., 1940, p. 105.)

## 41. ST. LUCIA WHITE-BREASTED THRASHER

*Ramphocinclus brachyurus sanctae-luciae* Cory

o; St. Lucia, April 25, 1927 (James Bond Coll.)

The last specimens seen were at De Barra and Grande Anse in 1932. Since then no specimens have been recorded although it has been looked for. (Bond, l. c., p. 106.)

## 42. MARTINIQUE TREMBLER

*Cinclocerthia ruficauda gutturalis* (Lafresnaye)

2 o; no data (Rivoli Coll.)

This thrasher began to disappear in about 1878. Although very rare today it probably still survives. (Bond, Check-list Bds. W. Ind., 1940, p. 105.)

## 43. NORTH ISLAND THRUSH

*Turnagra tanagra* (Schlegel)

♂, ♀; New Zealand (Rivoli Coll.)

Once this species inhabited all the forested areas of North Island, New Zealand. The last definite record of it was in 1900 when four specimens were obtained. In 1909 some were said to exist in the Parahaki district. (Oliver, New Zeal. Bds., 1930, p. 448.)

Stidolph classes it as almost extinct. (Emu, 33, 1933, p. 10.)

## 44. SOUTH ISLAND THRUSH

*Turnagra capensis* (Sparrrman)

♂, ♀; New Zealand (Rivoli Coll.)

♀; New Zealand, 1877 (Tristram Coll.)

o; Taipo, New Zealand, 1875 (Tristram Coll.)

This thrush was once exceedingly common in the forests of South Island, but by 1870 it was already becoming rare. In 1930 it was confined to the southwestern corner of South Island. (Oliver, New Zeal. Bds., 1930, p. 448.)

Stidolph classes it as almost extinct. (Emu, 33, 1933, p. 11.)

## 45. ISLE OF PINES SOLITAIRE

*Myadestes elisabeth retrusus* Bangs and Zappey

♂; Isle of Pines, March 13, 1934 (James Bond Coll.)

This member of the thrush family is of particular interest for it is the only one of the genus to live at sea level.

But two specimens of it are known. Of it Phillips simply said "extinct" (Verh. VI Int. Orn. Kongr., Copenhagen, 1926, p. 259). However, Bond secured a specimen in 1934.

Today it is confined to a small area of the Isle of Pines (Paso Piedras) and even there it is rare. (Bond, Check-list Bds. W. Ind., 1940, p. 111.)

## 46. GRAND CAYMAN THRUSH

*Mimocichla ravidia* Cory

♂; Grand Cayman, April 5, 1892 (Cory Coll.)

When W. W. Brown went to Grand Cayman I. in the Carribean in 1911, this thrush was found in "only two remote patches of woodland." Since then the bird has not been seen (Bond, l. c., p. 109).

## 47. GUADELOUPE THRUSH

*Cichlherminia l'herminieri l'herminieri* (Lafresnaye)

♀; Guadeloupe I., Aug. 27, 1914 (G. K. Noble Coll.)



This thrush was considered a game bird and much persecuted by "hunters." The mongoose also found it easy prey on account of its terrestrial habits.

A number of specimens were taken in 1914 by Noble, but in 1929 it was reported extinct or nearly so.

In 1937 a few were seen on the lower slope of the Soufrière Volcano, and Danforth considered it rare but not in immediate danger (Journ. Agr. Univ. Puerto Rico, 23, 1939, p. 37).

48. † LAYSAN WARBLER

*Acrocephalus familiaris familiaris* (Rothschild)

♂ ; Laysan I., Hawaiian Group, June 16, 1891 (H. C. Palmer Coll.)

This dull-colored little warbler was described in 1892. In 1903 it was one of the most abundant of the four land birds on Laysan (Fisher, Bull. U. S. Fish Comm., 1903, p. 38), but it became extinct after the imported rabbit had done its work. All the original specimens, of which ours is one, were so tame that they were caught by Palmer with a hand net.

The "Finch" (*Telespiza*) and the Rail (*Porzana*) are also extinct on Laysan, but both are plentiful on Midway Island, where they were fortunately introduced when it was still possible to do so.

49. WESTERN BRISTLE-BIRD

*Dasyornis longirostris* Gould

♂ ; King Georges Sound (Gould Coll.) (= Type.)

♂ ; Australia (Rivoli Coll.)

o; Australia (Rivoli Coll.)

Major H. M. Whittell writes me (May 18, 1941) that this strange and aberrant warbler "may be extinct nowadays in W. A. [Western Australia], but possibly not." No specimen of it has been seen for approximately twenty years.

50. † THE O-O

*Acrulocercus nobilis*

4♂, 6♀ ; Sandwich Is. (Andrew Garret Coll.)

♂ ; Sandwich Is. (J. G. Strain, U.S.N., Coll.)

2♂, 2♀ ; Sandwich Is., 1840 (U. S. Exploring Expedition)

Palmer says that in 1892 the O-O was a common bird of the lower forest in the Kona District of Hawaii (Ibis, 1893, p. 109). Sir Alfred Newton writing to Dr. Stone in 1899 said "I understand *A. nobilis* to be becoming scarce and will probably be extinct in no long time."

Baldwin says that this species is extinct today. It was last recorded by Henshaw in 1902, who saw specimens of it in the Hilo district (Nat. Park Serv. Pub., Jan. 1941).

The Honey-eaters have very strange-sounding native Hawaiian names. For more about Hawaiian birds see under the Akialoa (*Hemignathus o. obscurus*) no. 56 of this paper.

#### 51. THE O-O A-A

*Acrulocercus braccatus* (Cassin)

o; Kauai, 1835 (J. K. Townsend Coll.) (Type)

Delacour believes that this species and *Acrulocercus bishopi* of Maui still exists, without doubt, today. (Ois., 1928, p. 245.)

#### 52. STITCH BIRD

*Notiomystis cincta* (Du Bus)

3 ♂; North I., New Zealand (Rivoli Coll.)

♀; North I., New Zealand (Tristram Coll.) (Iris is marked as black).

Of this pretty little honey-eater Sir Walter Buller writing in 1888 says "The Stitch-bird, which less than 15 years ago was comparatively plentiful in the southern portion of North Island (New Zealand) is now quite extinct on the mainland, being met with only on a small wooded island in the Hauraki Gulf." (Bds. New Zealand, 1, 1888, p. 242.)

Oliver (Bds. N. Zeal., 1930, p. 491) says that the Stitch-bird is quite extinct on the mainland. It survives only on the mountain tops of Little Barrier I., an island 4½ miles long by 3½ miles wide. (Oliver, Emu, 22, 1922, p. 51.)

Stidolph notes this bird as bordering on extinction (Emu, 33, 1933, p. 10).

#### 53. † CHATHAM ISLAND BELL-BIRD

*Anthornis melanura melanocephala* Gray

♀; Little Mangare. I., 1892 (H. O. Forbes, Tristram Coll.) The iris is noted as "Blue-black with yellow-orange ring."

o; Chatham, 1892 (H. O. Forbes, Tristram Coll.)

This honey-eater was discovered in 1839. By 1890 it was scarce and by 1924 it had entirely disappeared. Both Oliver (New Zeal. Bds., 1930, p. 491) and Stidolph (Emu, 33, 1933, p. 12) say that it is quite extinct.

Fleming gives about 1906 as the date when it vanished. (Emu, 38, 1939, p. 389.)

The Chatham Island Robin (*Miro traversi* Buller) which is listed in Rothschild's "Extinct Birds" (1907, p. 15) was found by Fleming still to

exist on Little Mangare. He estimated (1939) the population as at the most 35 pairs, and at a conservative estimate 20 pairs.

It became extinct on Mangare soon after cats were liberated early in the present century. The brushy area on the summit of Little Mangare inhabited by the survivors of this species is hardly an acre in extent (Fleming, l. c., p. 383).

The Chatham Island Fern-bird (*Bowdleria rufescens* Buller) was not found by Fleming, who believes that its chances of having survived are very small. Apparently the last bird seen was one secured by one of the Rothschild collectors on Mangare. (Fleming, l. c., p. 505.)

#### 54. † THE HUIA

*Heteralocha acutirostris* (Gould)

♂ ; New Zealand (Gould Coll.) (Type of *Neomorpha crassirostris* Gould)

♀ ; New Zealand (Gould Coll.) (Type of *Neomorpha acutirostris* Gould)

♂, ♀ ; New Zealand (Rivoli Coll.)

It is most unfortunate that this very remarkable honey-eater has vanished.

The male and female are so different, the latter having a long curved bill, and the former a much shorter and straight one, that Gould described them as belonging to different species. This difference in structure is unique among birds.

The Huia occurred on North Island, New Zealand, where it never left the deepest parts of the forest. It was first discovered in 1835.

The Maoris used Huia feathers for decoration, also the entire skins, after the wings and feet had been removed, as ear-pendants.

The last specimens to be seen alive were two males and a female in 1907. Oliver says that it is "now probably extinct." (New Zeal. Bds., 1930, p. 495.)

Stidolph places it definitely on the extinct list (Emu, 33, 1933, p. 10).

#### 55. SADDLEBACK

*Philesturnus carunculatus carunculatus* (Gmelin)

2♂ ad., 4♂ imm., 0; New Zealand (Rivoli Coll.)

0; New Zealand

The South Island Saddleback was once common throughout New Zealand but has become very scarce, and is now confined to very few localities (Oliver, New Zeal. Bds., p. 499).

Stidolph says it is almost extinct (Emu, 33, 1933, p. 10).

Stead writes that the "South Island form is at best extremely rare on the mainland, and the only indication I have been able to get that it still

exists, being an observation by Major R. A. Wilson, who thinks he heard one some three years ago in South Westland." (Ibis, 1936, p. 596.)

56. MAURITIUS OLIVE WHITE-EYE

*Zosterops curvirostris curvirostris* Blyth

4 ♂; Mauritius (Rivoli Coll.)

Another species, now rare, and confined to the southwest part of the island when last reported. Meinertzhagen who spent a year in Mauritius (1911) saw one bird in January of that year, and three in February (Ibis, 1912, p. 88).

57. THE AKIALOA

*Hemignathus obscurus obscurus* Gmelin

♂; Hawaii, 1840 (U. S. Exploring Exped.)

This and the following thirteen species with strange native names belong to the family Drepanididae. This family is found only on the remote Hawaiian Islands, and is probably related to the tropical American Sugarbirds (Coerebidae).

Through thousands of years of isolation the Drepanids have become highly differentiated. Today some have very long sickle-shaped bills, and others stout, finch-like ones. Two have bills like a parrot's. In size the birds themselves vary from that of a warbler to that of a grosbeak. All have a tongue ending in a "brush" suitable for feeding on the nectar of flowers. However, owing to the competition for survival on such a limited land area as the Hawaiian group of islands, each species has had to modify its feeding habits so that there would be enough food for all. Hence the different shapes of the bills in the different genera.

Although all probably started as nectar feeders, today some live on seeds of trees, others live on insects which they dig out of the bark, a few have gone so far afield as to have learned to eat seabirds' eggs,\* and still others have retained the ancestral habit of living on nectar and pollen.

Unfortunately when white men arrived this beautiful balance was upset.

Migration took the form of local vertical movements up and down the high mountain, following the succession of ripening seeds and opening flowers. When cattle were introduced, and the forest on the lower slope of the mountains cut down and replaced with imported grasses for cattle feed, the effect on Hawaiian birds was the same for them as if South and Central America suddenly sank below the waves for our North American migrants.

The Drepanids' winter food supply on some islands was sharply reduced or cut off entirely. Through centuries of isolation they had become so

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\* George Vanderbilt has excellent colored moving pictures showing a Nihoa "finch" (*Telespiza c. ultima*) eating a tern's egg.

highly specialized that they were unable to adapt themselves to the changed condition of their surroundings.

Thus today many of the species belonging to this family have become extinct, and others have become so reduced in numbers that they are frightfully rare or on the verge of disappearing altogether.

Baldwin gives the following list of birds imported and liberated on the Hawaiian Islands:

Ring-necked Pheasant, Chicken, Turkey, California Quail, Chinese Dove (*Streptopelia*), Asiatic Ground Dove (*Geopelia*), Australian Gallinule (*Gallinula*), an Australian Parroquet (*Platycercus*), a Babbler (*Garrulax*), a Chinese Starling (*Acridotheres*), the Skylark, the Mexican House Finch, and the Spice Finch (*Lonchura*). (Nat. Park Serv. Pub., Jan. 1940.)

A very complete list of all the birds which had been imported to the islands up to 1933 is given by Caum. Fortunately many have disappeared again. (Occ. Pap. Bishop Mus., 10, 1933, p. 771.)

That some imported birds are able to spread from one island to another is well shown by Fisher's experience.

"... fifty miles southwest of Niihau, a flock of Mynahs (*Acridotheres tristis*) appeared in the neighbourhood of the vessel. . . . Finally several perched on the fore-topgallant yard . . . late in the afternoon they left the ship.

"It is of interest to find such a land-lover as the Mynah so far out at sea, and it shows also that before long the chain of Leeward Islands (Hawaiian Group) may become gradually colonized with them" (Bull. U. S. Fish Comm., 23, 1903, p. 771).

To tip the scales still further against the native bird population, the mongoose has been liberated.

Another and a very important factor is the introduction of montane forms of birds (*Lioptila*, *Zosterops*, etc.) and consequently their diseases. Vast stretches of forest on Hawaii, Maui, Molokai and Kauai are still untouched by man, but his introduced birds are there competing with the native ones, and the diseases imported with them are an ever present danger.

The Akialoa, found nowhere but on Hawaii, is very scarce today (Delacour, Ois., 1928, p. 220). C. E. Blacow saw it on the windward side of the island in 1940 (Baldwin, Nat. Park Serv. Pub., Jan. 1941).

#### 58. THE IIVI OR AKIALOA OF KAUAI

*Hemignathus procerus* Cabanis

♀ ; Kauai, 1835 (J. K. Townsend Coll.)

Not as rare as *H. o. obscurus* (Delacour, Ois., 1928, p. 220) ; in Palmer's day this was also true. Restricted to Kauai of the Hawaiian group.

## 59. THE NUKUPUU

*Heterorhynchus lucidus hanapepe* Wilson

♂; Sandwich Is. (Rivoli Coll.)

According to Delacour all the forms belonging to this genus are either extinct or very rare (Ois., 1928, p. 220).

Rothschild says "Palmer found this species very scarce. All he procured were collected on the southern side of Kauai . . . all within a range of fifteen miles" (Bds. Laysan, p. 102, 1907). Palmer collected on Kauai in the 1890's.

This species is found only on Kauai.

## 60. THE AKIAPOLAAU

*Heterorhynchus lucidus affinis* Rothschild

♀; Sandwich Is., 1835 (J. K. Townsend Coll.)

This form is restricted to Maui of the Hawaiian group.

## 61. † THE LAYSAN APAPANE

*Himatione sanguinea fraithii* Rothschild

♂; Laysan, May 23, 1907 (Max Schlemmer Coll.)

This bird, which inhabited Laysan I., of the Hawaiian group, was first described in 1892. In 1903 it was the least abundant of the land birds indigenous to the island, but still it was not rare. (Fisher, Bull. U. S. Fish Comm., 1903, p. 35.)

The introduction of rabbits which destroyed the vegetation, and thus its food supply, caused its extinction in 1924.

## 62. NO NAME

*Viridonia sagittirostris* Rothschild

♀; Kauvihi, Hawaii, Jan. 25, 1900 (H. W. Henshaw Coll.)

When last heard of this bird was restricted to a patch of forest along the Waikulu River between 2100 and 4000 feet. It is probably now extinct (Delacour, Ois., 9, 1928, p. 242).

Rothschild reports this bird was already rare in 1892 (Bds. Laysan, p. 109).

Baldwin says that it has remained unrecorded for 40 years (Nat. Park Serv. Pub., Jan. 1941).

The fact that this bird has no recorded native name may point to the fact of its being little known.

## 63. THE MOLOKAI MAMO

*Palmeria dolei* (Wilson)

♂ ; Molokai, Sept. 13, 1893 (R. C. L. Perkins Coll.)

This extraordinary-looking bird probably still exists, but only in very reduced numbers, on a few mountain tops in Maui and Molokai (Delacour, Ois., 9, 1928, p. 243).

## 64. † THE MAUI AKEPEUIE

*Loxops coccinea rufa* (Bloxam)

♂ , ♀ ; Oahu, 1835 (J. K. Townsend Coll.)

The last specimen seen alive was one shot by Wolstenholme in the mountains of the Wailua District, Oahu, on April 20, 1892. It is generally considered to be quite extinct.

A second male of this bird was exchanged to Sir Alfred Newton at Cambridge University, England, in 1899.

## 65. THE OU-HOLOWAI

*Chrysomitridops caeruleirostris* Wilson

♂ ; Kauai, 4000 ft., May 1894 (R. C. L. Perkins Coll.)

Found only on Kauai of the Hawaiian group.

## 66. † THE OAHU OU

*Psittirostra psittacea deppei* Rothschild

♂ , 3 ♀ ; Sandwich Is., 1835 (J. K. Townsend Coll.)

This bird is now extinct. It occurred only on the island of Oahu which was visited by Townsend in 1835 after having crossed the American continent with packhorses.

Within the last ten years the Ou (*P. p. psittacea*) has become very rare on all the islands which it inhabits.

## 67. THE PALILA

*Loxioides bailleui* Oustalet

♂ ; Hawaii, 1889 (Scott B. Wilson Coll.)

Now found only in the district of Kona and Hamakua on the island of Hawaii.

## 68. † THE KOA "FINCH"

*Rhodacanthis palmeri* Rothschild

♂ ; Roona, 4000 ft., Hawaii, July 1892 (R. C. L. Perkins Coll.)

Although a member of the Drepanid family this extraordinary bird has a bill like that of a grosbeak.

In 1928 it was said by Delacour to be very rare or perhaps extinct. It lived only in the Kona and Kau districts of the island of Hawaii (Ois., 9, 1928, p. 245). In 1890, when Palmer collected, it was not rare.

Today it is regarded as extinct by Baldwin, for no specimen of it has been seen since about 1890. (Nat. Park Serv. Pub., Jan. 1941.)

#### 69. BISHOP'S WARBLER

*Catharopeza bishopi* (Lawrence)

2 ♂, 3 ♀; St. Vincent, 1927-1929 (James Bond Coll.)

The range of this bird is now reduced to about one square mile in the virgin forest of the southern mountains of St. Vincent.

It was believed extinct but was rediscovered in its limited habitat by Gerald Thayer.

On account of the arrival of the Cow Bird on St. Vincent, the last remnants of this interesting species are placed in a very precarious position (Bond).

#### 70. SEMPER'S WARBLER

*Leucopeza semperi* Selater

♂; St. Lucia (John Semper Coll.)

♂; St. Lucia (Frederick Ober Coll.)

Once widespread, today it is excessively rare if not extinct. Last taken on the summit of Piton Flore, in St. Lucia, in 1934.

The few specimens known were almost all collected by Semper, for whom the bird was named, in about 1870 (Bond.)

#### 71. MAURITIUS WEAVER BIRD

*Nesacanthus rubra* (Gmelin)

♂, ♀; Mauritius (Rivoli Coll.)

In 1911 the Mauritius Weaver was disappearing rapidly and "was a rare bird even in the southwest of the island." Meinertzhagen saw five birds in February 1911. (Ibis, 1912, p. 93.)

Mauritius is an island in the Indian Ocean about 600 miles off the coast of Madagascar. It was the home of a most astonishing avifauna which included the Dodo. From the moment the island was discovered man and imported pests set immediately to the task of exterminating the birds for food or for "sport." There were no land animals to hunt.

Today nothing but a pitiful remnant of what was once perhaps the most remarkable avifauna in the world is left.



Meinertzhagen, who spent a year in Mauritius, says "The pig has succeeded in extirpating the ground birds, . . . the monkey (introduced) is now hard at work on the aboreal species" (l. c., 1912, p. 84).

He further says "It is a peculiar fact that all proved native birds of Mauritius should be so confiding. Without one single exception they are ludicrously tame. Also nearly all of them have a sad plaintive note, and even their alarm note is more a cry for mercy than a scream of terror" (l. c., p. 84). To speed matters the mongoose has also been introduced.

Of the 32 species of land birds found on the island today, 20 have been introduced, leaving only 12 indigenous birds surviving.

Oustalet has written a most interesting paper on the fauna of the Mascarene Islands which is well worth reading by those who are interested. (La Faune Orn. Ancienne et Moderne des Îles Mascareignes, Ann. Sci. Nat., Zool., (8), 3, 1896, p. 1.)

72. † ST. KITTS BULLFINCH

*Loxigilla portoricensis grandis* Lawrence

♂ ; St. Kitts (Frederick Ober Coll.)

This bird was exterminated by the Macaque Monkey which was introduced on the island (Bond, Check-list Bds. W. Ind., 1940, p. 153).

The exact date of its extinction is not known, but it was probably at the turn of the century.

73. GUADELUPE JUNCO

*Junco insularis* (Ridgway)

♂ , ♀ ; Guadelupe I., Sept. 20, 1896 (Robt. Sharpless Coll.)

Phillips said in 1926 that this bird was at that time almost extinct.

Before 1911 this very distinct junco was the commonest bird on the island, but by 1922 it had become rare, and in 1925 only two specimens were seen, both of which were collected. (Phillips, Verh. VI Int. Orn. Kongr., Kopenhagen, 1926, p. 515.)

In recent years this species appears to have increased again. George Vanderbilt visited Guadelupe in July 1941, during his most recent expedition for the Academy, and the Junco was found not to be uncommon. Dawson A. Feathers, Vanderbilt's collector, writes me that he saw about 100 individuals, but that their distribution was very limited. Most of the specimens seen were found among scattered pine trees which grow on the crests of the hills at the north end of Guadelupe. This pine-covered ridge extends for about a mile, and as but one-third of it was visited, Feathers thinks it fair to assume that the junco population of Guadelupe must be in the neighborhood of 300 birds.

While on the island about 20 Purple Finches (*Carpodacus mexicanus amplius*) were observed. The Rock Wren (*Salpinctes obsoletus guadeloupensis*) was found to be plentiful everywhere except in the cold, humid, pine tree area.

### RARE BIRDS

#### 74. BLACK-CAPPED PETREL

*Pterodroma hasitata* (Kuhl)

o; no data (Rivoli Coll.)

A very rare bird in collections. It formerly bred in Guadeloupe and Dominica but probably breeds today only in Hispaniola.

#### 75. BRUIJN'S MEGAPODE

*Aepyodius bruijnii* Oustalet

♀; Jeimon, Waigau, Nov. 30, 1938 (Joseph Kakiaj Coll.)

This singularly ugly megapode looks like a vulture, with a wattle appended to the front of its neck.

It was first described in Paris in 1880 from a specimen sent by Bruijn. He said it had come from Waigau, an island off the west coast of New Guinea. He got in all about 11 specimens, all that were known.

Subsequently several expeditions went to Waigau, some with the express purpose of finding the megapode, but all returned empty-handed.

As Bruijn was primarily a plume collector, and his men were never too sure as to where their specimens had come from, the locality Waigau was given up and the bird was thought to come from New Guinea.

In 1938 the Academy sent a native collector to Waigau with instructions to look for the megapode, but it must be confessed with little hope that he would find it.

To our surprise and delight, however, he did succeed and thus the mystery was solved. Bruijn had been right.

#### 76. UNICORN CURASSOW

*Pauxi unicornis* Bond and de Schauensee

♂, ♀; Palmar, Cochabamba, Bolivia, July 20, 1937 (M. A. Carriker, Jr. Coll.) (♂ = Type)

During the Academy's survey of Bolivia these two extraordinary birds were shot. That an edible bird the size of a turkey, with a two and a half inch bony horn on the top of its head should have gone unknown until 1937 seems almost impossible. As yet the only specimens of this strange bird are the two in the Academy.

It is also of interest that the single other member of this genus is definitely known only from far-away Venezuela.

77. ATJEH FIRE-BACK

*Houppifer hoogerverf* Chasen

♀ ; Meloewak, North Sumatra, May 9, 1939 (George Vanderbilt Coll.)

This species of pheasant is known from the type (a female), and our specimen.

It would be most interesting to know what the male will look like.

78. DA CUNHA'S RAIL

*Atlantisia rogersi* Lowe

♀ ; Inaccessible I., Nov. 1928 (P. Lindsay Coll.)

2 ♂ ; Inaccessible I., Nov. 1936 (P. Lindsay Coll.)

This tiny rail "is the smallest flightless bird known to exist or to have existed." (Lowe, Ibis, 1928, p. 131.)

It inhabits only Inaccessible I. of the Tristan da Cunha group, which is the most isolated group of islands in the world, situated in the South Atlantic 1800 miles from the Cape of Good Hope, Africa, and 3000 miles from the mouth of the Rio de la Plata in Argentina.

Some sheep and cattle have been liberated on the island, but as yet no rats have arrived. If they do it will probably be the end of this rail.

79. GIANT SNIPE

*Capella undulata gigantea* Temminck

♂ ; Peru (Rivoli Coll.)

This enormous snipe stands about 13½ inches high and has a bill 4¾ inches long.

It is very rare and little is known about it. The few specimens in collections have been taken at very scattered localities in Brazil, Paraguay and eastern Argentina.

80. GOLDMAN'S QUAIL-DOVE

*Oreopelia goldmani* (Nelson)

♀ ; Mt. Sapo, 3000 ft., Darien, eastern Panama, May 3, 1941 (George Vanderbilt Coll.)

During George Vanderbilt's recent expedition to Panama, he and his collector, Dawson Feathers, were fortunate in securing a specimen of this beautiful dove, which was made up into an exemplary skin.

Goldman's Quail-Dove was first discovered in eastern Panama by Goldman who secured specimens on Mt. Pirri in 1912. I know of no other

specimens than the original five which were secured by Goldman at that time, with the exception of ours.

#### 81. KRUSENSTERN'S PIGEON

*Gallicolumba rubescens* (Vieillot)

♂, ♀; Hatutu, Marquesas Is., Oct. 1922 (R. H. Beck Coll.)

This pigeon was known for 115 years only from a painting made on Krusenstern's voyage around the world in 1807.

The name given to the bird on the plate was simply "Der Kokuh." It was said to come from Nukuhiva in the Marquesas Is. Vieillot gave the bird a Latin name in 1818 and from then on nothing more was heard of it.

It was often wondered whether or not the artist of the expedition had painted "Der Kokuh" from his imagination to while away a dull afternoon. However, in 1922, R. H. Beck, during the Whitney Expedition of the American Museum of Natural History, New York, landed on Hatutu and to his amazement there was the pigeon. It was also found on nearby Fatuhuku.

Beck, armed with a picture of "Der Kokuh" had previously visited many islands in the Pacific, shown the natives his picture in the hope that they would recognize the bird, and gone away disappointed.

It is said that Beck on that October evening of his discovery dined on "Der Kokuh" to celebrate his good fortune.

#### 82. BANDED PHEASANT-CUCKOO

*Neomorphus radiolosus* (Sclater and Salvin)

♀; Rio Michengue, western Colombia, July 1938 (K. von Sneidern Coll.)

There are only six other specimens known of this large cuckoo. All the previous ones were collected in northwestern Ecuador, except for a male from La Costa, western Colombia, shot in 1937. (Gyldenstolpe, Arkiv. f. Zool., 33, no. 6, p. 16, 1941.)

#### 83. SALVADORI'S OWL

*Otus beccarii* Salvadori

♂, ♀; Korrido, Biak, Nov. 1937 (S. D. Ripley Coll.)

This owl is particularly interesting as it is the only member of the genus *Otus* found in the New Guinea region. Biak lies in Geelvink Bay off the north coast of New Guinea.

A male was collected by Odoardo Beccari in May 1875, and the specimen remained unique until the above two were secured. They are today the only three specimens known.

## 84. GURNEY'S HORNEO OWL

*Mimizuku gurneyi* (Tweeddale)

♀, ♀ juv.; Lake Lanao, Mindanao, 1906-07 (Clemens Coll.)

Hachisuka says that only two specimens of this owl from the Philippines exist, and that they are in the British Museum. (Birds Phil. Is., 2, 1932, p. 71). He apparently did not know of our two.

## 85. PÈRE DAVID'S OWL

*Strix davidi* (Sharpe)

♂; Batang, Szechwan, West China, Dec. 1934 (Brooke Dolan Coll.)

This owl was first described in 1875. It is only known from three or four specimens.

## 86. BREWSTER'S GOATSUCKER

*Siphonorhis americana brewsteri* (Chapman)

3♂, 5♀, 30; Gonave Island, May-June 1928 (James Bond Coll.)

This nightjar was first known from a single specimen taken in the Dominican Republic by R. H. Beck in 1917. Kaempfer shot three more in 1924. In 1928 Bond secured a series on Gonave Island, Haiti.

The bird is very rare in collections for the only specimens known to have been taken are the ones listed above. It is of particular interest as it is a subspecies of the extinct Jamaica Nightjar, which disappeared in the middle of the 19th century.

## 87. CASSIN'S GOATSUCKER

*Caprimulgus serico-caudatus serico-caudatus* Cassin

20 = ♂; South America (Rivoli Coll.) (o, no. 21905 = Type)

♀; Curytiba, southeastern Brazil, Feb. 28, 1940 (A. Meyer Coll.)

In 1849 Cassin, curator of birds at the Academy, described this bird, but not knowing the exact locality from which it came, marked it simply South America. Both his specimens were males.

We have received the above female which we believe belongs to this species. It and another female from Santarem on the Amazon in the Carnegie Museum are the only known specimens with locality. (Grisom & Greenway, Bull. Mus. Comp. Zool., 88, no. 3, 1941, p. 165.)

## 87. GOETHAL'S HUMMINGBIRD

*Goethalsia bella* Nelson

20; Mt. Pirri, 5300 ft., March 29, April 7, 1938 (Pearson Coll.)

0; Mt. Sapo, 3000 ft., May 3, 1941 (George Vanderbilt Coll.)

First collected in eastern Panama in 1912 by Goldman. Only the original three specimens were known until Pearson secured an additional three in 1938. A further example was secured by George Vanderbilt and his collector, Dawson Feathers.

89. GREAT FORK-TAILED HUMMINGBIRD

*Hylonympha macrocerca* Gould

♂ ; "Northern Brazil", 1887 (From H. Whiteley)

The real habitat of this large hummingbird, which measures about 6 inches in length, remains a mystery.

A small number of specimens have been secured as trade skins, but from the day in 1873 when it was first described by Gould up to the present, nobody has found out from where it comes. Several guesses have been hazarded as to its habitat; Venezuela, North Brazil, etc., have been suggested, but its true home is still unknown.

89A. DOUBLE-BANDED SOFT-TAIL

*Xenerpestes minlosi* Berlepsch

o; Garachiné, E. Panama, April 20, 1941 (George Vanderbilt Coll.)

Included in a late shipment of birds from Panama collected by George Vanderbilt was a specimen of this very rare and singular bird.

Described in 1886, only eight specimens of it have ever been found.

90. BOLIVIAN WOODHEWER

*Simoxenops striatus* (Carraker)

2 ♂, ♀; Santa Ana, 2200 ft., Bolivia, July 1934 (M. A. Carraker, Jr. Coll.) (♂ = Type)

♀; Palmar, 2600 ft., Bolivia, July 1937 (M. A. Carraker, Jr. Coll.)

This species is known only from specimens collected by the Academy's expedition to Bolivia.

91. CHAPMAN'S ANTbird

*Xenornis setifrons* Chapman

2 ♀; Baudo, 1800 ft., Colombia, July 26, 1940 (K. von Sneider Coll.)

This monotypic genus was discovered in Panama in 1930, when a single male was secured. Two more males were found in 1937.

The Academy has just received two females, the first known, of this very interesting genus. They came from Colombia, thus considerably extending the known range of the bird.

## 92. YELLOW-BREASTED ANTPITTA

*Grallaria flavotincta* Sclater

♂ ; Ricuarte, 3900 ft., Colombia, Apr. 25, 1941 (K. von Sneider Coll.)

This antpitta was collected first by T. K. Salmon, who shot a single example near Frontino, Colombia, in 1876. An additional example, juvenile, was secured, perhaps a little later, by Salmon at Santa Elena. Both these specimens are in the British Museum.

No further specimens were seen until Mr. von Sneider collected two examples in 1935 at Munchique and La Costa in southwestern Colombia, both of which went to the Royal Natural History Museum in Stockholm (Gyldenstolpe, Arkiv. för Zoologi, 33A, no. 6, 1941, p. 14).

This species is very distinct, plain rufous-brown above, plain primrose-yellow below. A good colored plate of it may be found in the Ibis (pl. 9, 1877).

Our specimen is apparently the only one in America.

## 93. SCLATER'S CHATTERER

*Doliornis sclateri* Taczanowski

♂ ; Maraynioc, 10,800 ft., Prov. Junin, Peru (H. Watkins Coll.)

This cotinga must be excessively rare for although diligent search has been made for it, only three specimens have turned up since it was first described in 1874.

## 94. BEAUTIFUL JAY

*Cyanolyca pulchra* (Lawrence)

♀ ; Rio Munchique, 3000 ft., western Colombia, Dec. 1939 (K. von Sneider Coll.)

This is only the seventh specimen of this fine jay to have been found since it was first described in 1875.

The first three came from Ecuador without precise locality. The fourth was collected by Palmer on Tatamá Mountain, western Colombia, in 1908, and a pair at La Costa, western Colombia in 1937.

## 95. MISOL BIRD OF PARADISE

*Paradisaea minor pulchra* Mayr and de Schauensee

♂ , ♀ ; Tip, Misol (S. D. Ripley Coll.)

Although in this list I have not included rare subspecies of well known birds, this one has a particular interest attached to it, and, I have let it slip in.

The great naturalist, A. R. Wallace, writing in 1862 said "I have been assured by the Goram and Bugi traders that Misol was the very best country for Birds of Paradise, and that they were finer and more abundant there than anywhere else" (Proc. Zool. Soc. London, p. 156).

And again "He [Allen, Wallace's collector] was only able to get a single specimen . . . [in Misol] which is there finer than in most places."

Misol, off the western end of New Guinea, was a favorite hunting ground for the plumassiers, and this Bird of Paradise became almost extinct on the island. However, under wise protection it re-established itself and is now not rare in the interior of the island.

Through the courtesy of the Netherlands Indies Government the Academy was granted permission to collect in Misol in 1937.

When the collection from there arrived at the Academy it was immediately seen that almost 80 years ago Wallace had been quite right in his appraisal of the beauty of the Misol Bird of Paradise, and it was described as a new subspecies which differed from the mainland bird by its more beautiful plumes and richer colors.

#### 96. SIAMESE STACHYRIS

*Stachyris rodolphei* Deignan

♂; Doi Chiengdao, 5500 ft., Siam, Jan. 1933 (R. M. de Schauensee Coll.)

This curious little babbler is known today but from three specimens, all from the mountains of northern Siam.

#### 97. VANDERBILT'S BABBLER

*Malacocincla vanderbilti* de Schauensee

o; Koengke, 3100 ft., North Sumatra, May 5, 1939 (George Vanderbilt Coll.) (Type)

This babbler is known from a single example collected by George Vanderbilt in 1938.

#### 98. NAMIB FLYCATCHER

*Namibornis herero* (de Schauensee)

♀; Usakos, Southwest Africa Protectorate, June 28, 1930 (R. M. de Schauensee Coll.) (Type)

o; Omaruro, Southwest Africa Protectorate, July 4, 1930 (R. M. de Schauensee Coll.)

This curious bird was discovered by an Academy Expedition in 1930. Three years later Bradfield collected two more examples, and in 1938 a few more were secured.



The bird will never be common in collections for it is confined to a small and very arid section of the Southwest Africa Protectorate.

99. COOK ISLAND FLYCATCHER

*Pomarea dimidiata* (Hartlaub and Finsch)

♂, ♀; Raratonga, Cook Is., 1850 (Tristram Coll.)

The above two specimens were bought by Canon Tristram at the sale of Sir William Jardines' Collection.

The status of the bird is not well known. It is terribly rare in collections, our specimens being the only ones in America. Perhaps it belongs in the first section of this paper. Mayr informs me that there is a pair in the Bremen Museum, a pair in the Hamburg Museum, and in the Cambridge Museum in England a pair. Greenway tells me that there is a pair also in the Bishop Museum in Honolulu.

Mathews has proposed to separate this bird generically under the name of *Raratonga*.

100. YANAC FLYCATCHER

*Yanacea alpina alpina* Carriker

♂, ♀; Yanac, 15,000 ft., Peru, March 1932 (M. A. Carriker, Jr. Coll.)  
(♂ = Type)

This new genus of flycatcher is known only from three specimens collected by the Academy's expeditions, two from Peru and one (*Y. a. boliviana* Carr.) from Bolivia.

101. BICOLORED CACTUS WREN

*Heliodytes minor bicolor* Pelzelin

o; Colombia (Mantou et Cie., Paris)

The plumassiers, suppliers of feathers for the hat shop trade in Paris, have in the past been a happy hunting ground for rare birds. Today on account of restrictive laws, they are almost out of existence.

However, in Paris in 1937 I made an "expedition" to a plumassier to see what I could find. Besides some rare Birds of Paradise, I found this Colombian wren which is known from only 23 specimens, all of which have come from hat shop suppliers. What part of Colombia the bird inhabits is yet a mystery.

102. OBSCURE CHAT

*Larvivora obscura* Berezowsky and Bianchi

♀; Shulingou, June 7, 1931 (Brooke Dolan Coll.)

This bird is probably the only known female of this very rare chat. It was taken by the first Dolan expedition to western Szechwan, China.

103. PETERS' DACNIS

*Xenodacnis petersi petersi* Bond and de Schauensee .

3 ♂, 3 ♀; Yanac, 15,000 ft., Peru, March 1932 (M. A. Carriker, Jr. Coll.)  
(♂ = Type)

This recently described sugar-bird is known only from specimens collected by the Academy's expedition to Peru in 1932.

It is the second species belonging to this genus which has been discovered.

104. VERDITER SUGARBIRD

*Dacnis viguieri* Sclater and Salvin

4 ♂, 2 ♀; Juradó, Colombia-Panama border (Pacific side), Sept.-Oct. 1940 (K. von Sneidern Coll.)

The only known specimen of this beautiful verditer-green bird was a male collected in 1877 "dans l'isthme de Panama sur les bords du golfe de Darien" by Dr. Viguier. He sent the specimen to Oustalet and later the bird was described as a new species with "no near allies in the genus." Accompanying the description was a fine colored plate.

Sixty-four years passed before Viguier's Dacnis was rediscovered, during which time it was wondered if the bird might perhaps have been a hybrid or a freak.

During the Academy's survey of the Pacific fauna of Colombia, Kjell von Sneidern collected the above small series which included the first known females.

105. BLACK AND WHITE TANAGER

*Conothraupis speculigera* (Gould)

4 ♂, 3 ♀; Samne, 4500 ft., Dept. of Libertad, Peru, April 1933 (M. A. Carriker, Jr. Coll.)

This rare tanager was first collected in 1852 by Hauxwell in Peru, when two males were secured. These went to the British Museum. About 22 years later a Polish collector named Taczanowski secured three more males in Peru which were sent to the Warsaw Museum. No more specimens were seen until 1933 (or for about 50 years), when Carriker collected six males and three females. The females had never been seen before.

106. MT. PIRRI CHLOROSPINGUS

*Chlorospingus inornatus* (Nelson)

2 ♂; Mt. Sapo, 3000-4262 ft., Darien, Panama, April 1941 (George Vanderbilt Coll.)

Only two specimens of this very distinct tanager have been known heretofore. The first was collected in 1912, and the second in 1928, both on Mt. Pirri in eastern Panama. These examples are therefore the first to be taken at a locality other than Mt. Pirri.

George Vanderbilt secured the specimens for us in Panama where he has recently collected for the Academy.

107. CASSIN'S OROPENDOLA

*Gymnostinops cassini* Richmond

♀ ; Bandó, western Colombia, Oct. 1940 (K. von Sneider Coll.)

This large oriole was described in 1898, although the original specimen was collected in 1859 by the Michler Expedition during a search for a route for a canal to the Pacific.

For over 80 years the Michler specimen from the Rio Truando remained the only one known. Von Sneider's rediscovery of this lost species is a most welcome event.

Very recently Dr. Alexander Wetmore of the United States National Museum examined our specimen and then kindly inspected the type in Washington. He writes me, "I examined the type of *Gymnostinops cassini* to find that it agrees perfectly in the chestnut color of the sides with your specimen, . . . I would have no hesitance in considering this a valid species. It is barely possible, of course, that it is a color phase but I doubt this exceedingly."

108. BLACK FINCH

*Melanospiza richardsoni* (Cory)

♂, 2 ♀, 0; St. Lucia, May 1929 (James Bond Coll.)

The history of this bird is rather curious. It was first described in 1886 from two skins purchased by W. B. Richardson from a native who said the bird was found on St. Lucia. When subsequently no further specimen could be found on the island it was doubted if the original two specimens really had come from St. Lucia at all, and other places, even distant Galapagos, were suggested as its habitat.

In 1929 Bond went to St. Lucia and finally cleared up the mystery by securing a small series including the first known females. (Auk, 1929, p. 523.)

The bird is rare on the island.

## 109. WHITE-RIMMED ATLAPETES

*Atlapetes leucopis* (Selater and Salvin)

♀ ; La Plata, Huila, Colombia, 7800 ft., March 1939 (K. von Sneider Coll.)

This finch was for many years known only from the two original specimens in the British Museum. They bore no locality other than Ecuador. In 1932, after a lapse of 54 years Berlioz, at the Muséum d'Histoire Naturelle, in Paris, received a specimen from Las Palmas, southwestern Ecuador (Bull. Mus. d'Hist. Nat., Paris, 4, pt. 2, no. 6, 1932, p. 628). Our specimen is the fourth known example of this species and the first recorded outside of Ecuador.

## 110. DA CUNHA'S FINCH

*Nesospiza acunhae acunhae* Cabanis

♂ ; Inaccessible I., Nov. 1938 (P. Lindsay Coll.)

This species occurs also on Nightingale I., of the Tristan da Cunha group in the south Atlantic. Once common on Tristan da Cunha it has become extinct there through the work of cats and rats, which are not yet present on the islands on which it is now found.

## 111. TIBETAN SNOW FINCH

*Kozłovia roborowskii* (Prezwalski)

2 ♂, 2 ♀ ; Borhan-Bhoda Mts. (south of the Tsaidam swamp), 16,000 ft., June 1935 (Brooke Dolan Coll.)

This bird is very rare in collections, as it comes from the most inaccessible part of Tibet, at best a very inaccessible country. But very few specimens are known as its breeding grounds have been seldom reached.

Prezwalski, who discovered this bird in about 1886, had exceptional opportunity to study Tibetan birds. He was a cavalry general in the Russian army, and when the urge for exploration overcame him, he would cross into Tibet with his troop, and while he collected birds, his soldiers cleared the countryside of any Tibetans who were likely to give trouble. Occasionally a pitched battle would take place so that the general might reach a favorite hunting ground!

Hartert said in 1910 the only known example of this red finch was the one collected by Prezwalski (Vögel Pal. Fauna, 1, 1910, p. 139).

Since then a few more examples have been collected by a Russian expedition.

## 112. TIBETAN BUNTING

### *Emberiza koslowi* Bianchi

4 ♂, ♀; Jeykundo, 12,300 ft., Tibet, May 1935 (Brooke Dolan Coll.)

This very rare bunting seems to be restricted to the dry tributary valleys of the upper Yangtze and Mekong Rivers.

A very distinct species, it was described in 1904, and I believe the original specimens in Moscow were the only ones known until these specimens were taken.

## 113. CINNAMON SEED-EATER

### *Spermophila cinnamomea* Lafresnaye

♂; Brazil (Rivoli Coll).

"Aside from the type, whose present whereabouts are in doubt, the only specimens on record are three males obtained by Natterer near Porto do Rio Araguaya, Goyaz, preserved in the Vienna Museum." (Hellmayr, Cat. Bds. Amer., 11, 1936, p. 224.)

As the original bird was described by Lafresnaye in France and this skin comes from a French collection, it is not at all impossible that this specimen is the lost type. In any case it is one of four known examples.

ABSTRACTS OF MINUTES OF THE PROCEEDINGS OF  
THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA

FEBRUARY 18, 1941

Annual meeting of the Academy.

Thirty-three members present.

President, Charles M. B. Cadwalader, in the Chair.

Annual reports covering the year 1940 were presented by the President, the Treasurer, the Chairman of the Museum Exhibits Committee, the Librarian, the Chairman of the Library Committee, and the Curator of the Department of Geology and Paleontology.

The following changes in membership since the last report, were presented as follows:

*Life to Associate Sustaining* (1)

George S. Munson.

*Annual to Life* (3)

Mrs. J. Norman Henry, Miss Anna Warren Ingersoll, Livingston E. Jones.

*Junior to Annual* (1)

Miss Winifred Boericke.

*Contributing to Annual* (1)

Mrs. Howard Wurts Page.

During the year a total of 149 new members were elected to the Academy in the following classes:

*Sustaining* (1)

George A. Coventry.

*Associate Sustaining* (1)

Henry W. Breyer.

*Life* (3)

J. Gibson McIlvain, R. W. Woodruff, Mrs. Minturn Wright.

*Non-Resident* (1)

Miss Bertha D. Benson.

*Contributing (1)*

Elias F. Buckley.

*Annual (131)*

Robert C. Alexander, R. David Anderson, Miss Edna M. Antrobus, Frank D. Bain, Walter J. Beadle, Edward F. Beale, Joseph S. Beckman, Miss Eleanor Wilson Borden, John A. Borden, Mrs. Robert Bradford, George Bradt, Miss Elizabeth Norris Brock, George Bur, Judson C. Burns, Fred William Cadwallader, Major Aaron E. Carpenter, Richard B. Chillas, Jr., Mrs. A. J. County, Mrs. Alan Crawford, Mrs. Charles T. Cresswell, Mrs. Constance C. Chrichton, William M. David, Miss Eleanor Bushnell Davis, Nelson C. Denney, Mrs. John Dilks, Mrs. Widener Dixon, Mrs. Charles B. Doak, John Dornan, W. W. Doughten, S. E. Downs, Mrs. Frederick Betts Driver, Frederick B. Driver, Mrs. James Ashmore Dunlap, W. Kirkland Dwier, Miss Doris Earle, Ervin R. Edgecomb, Miss Gertrude Eldridge, Henry Howard Ellison, Jr., S. E. Fairchild, Jr., L. W. Fisher, Mrs. L. W. Fisher, Mrs. A. G. Fromuth, Dr. Kenneth E. Fry, W. A. M. Fuller, Mrs. Hamilton Gilkyson, Jr., Mrs. Emma V. Gilligan, Edward H. Gilligan, Mrs. Chas. F. Griffith, Miss Mary Edith Guckes, George W. Haag, Jansen Haines, John P. Hallahan, Bertram Hanson, Newton Hartman, Ledyard Hecksher, J. Earley Helweg, Jr., Dr. Edwin R. Helwig, Mrs. John Hemphill, Dr. Leon Herman, Linwood W. Hirsch, Ambrose Hunsberger, William H. Hutt, Miss M. Keasbey, Mrs. Gail King, Clifford E. Kolb, Mrs. Arthur C. LaDow, Stephen R. Laslocky, LeRoy R. Levis, Shippen Lewis, Esmond R. Long, Mrs. C. S. Lott, Mrs. George H. Lorimer, Horace D. McCann, Gilbert S. McClintock, William Lewis McGee, D. Raymond McNeal, Miss Esther Means, Reverend A. C. Mieke, W. A. Millspaugh, Dr. John B. Montgomery, Dr. Thaddeus L. Montgomery, Robert Alexander Montgomery, Robert W. Murphy, Miss Eleanor Muschert, William Bunn Myers, Edmund H. Nash, Jr., D. A. Newhall, Miss Dorothy Noe, Miss Valeria F. Penrose, W. H. Phelps, Howard G. Platt, Miss Helen Ramsay, Hubert F. Ravenscroft, Miss M. Dorothy Reed, Garrett L. Reilly, Dr. John D. Reese, Robert Riggs, Thomas B. K. Ringe, A. Bantwell Roane, Mrs. Samuel P. Rotan, Miss Marie W. Rumpp, John M. Sailer, Frank A. Sartori, Jr., Merle S. Schaff, Maxwell Schubert, R. Barclay Scull, William Spawn, A. M. Stackhouse, J. Clinton Starbuck, Mrs. W. Plunket Stewart, Mr. J. L. Swinchart, Miss Ethel M. Sudders, Harry Thayer, Mrs. Randall Thompson, Granville Toogood, Mrs. Charles Z. Tryon, Dr. Creighton H. Turner, Sidney F. Tyler, Miss Mary G. Tyler, Joseph B. Van Seiver, Harry T. Walker, Reverend Horace A. Walton, Mrs. Palmer Watson, J. Harold Watson, Miss Helen F. Wartman, Mrs. William J. Weiheymayer, Oscar W. Weisel, Miss Frances S. Weston, Mrs. Russell G. Williams, David R. Wilmerding, Miss Beatrice A. Wilson, Howard A. Wolf, Miss E. V. Young.

*Junior (11)*

Gordon Armistead, Louis R. Beck, Daniel Darreff, Jr., Paul Daniel, William A. France, Juan Munoz, Alexander Montgomery, Robert Leaming Montgomery, Grier Saunders, Robert W. Speers, John W. Trudell, Adolph Whitten Vogel, Raymond Weitzel.

During the year 1940 the Academy lost 45 members by death, as follows: Milton F. Baringer, Mrs. John S. Blackburne, Dr. P. Brooke Bland, Mrs. M. F. Bonzano, Henry G. Brock, Francis Shunk Brown, Herbert L. Clark, Gustavus W. Cook, Dr. Charles N. Davis, Dr. Nelson F. Davis, Thomas Dolan, Dr. Frederick Ehrenfeld, Adolph Eichholz, Dr. C. A. Ernst, Dr. Henry M. Fisher, Frank B. Foster, Mrs. John Fritsche, Mrs. James Woods Fry, J. R. Gilbert, William B. Griseom, R. Wistar Harvey, Theodore F. Jenkins, Horace C. Jones, Bertram Lippincott, James H. Little, Jacob Longnecker, John A. McCarthy, Mrs. George D. McCreary, Stephen C. Markoe, Dr. Edward B. Meigs, John S. North, Mrs. Naomi Pennock, Captain Richard Peters, M. P. Quinn, Dr. W. H. Reed, Dr. David Riesman, F. L. Scribner, S. F. Sharpless, Henry Tatnall, Dr. E. Winslow Taylor, Samuel M. Vauclain, John Wagner, Mrs. Charles D. Walcott, D. B. Wentz, Jr., Clement B. Wood.

Following their nomination as prescribed by the By-Laws of the Academy, the following individuals were elected members of the Board of Trustees for the period extending to the Annual Meeting, 1944: Cary W. Bok, Edwin G. Conklin, E. R. Fenimore Johnson, Arthur E. Newbold, Jr., C. M. A. Stine, George D. Widener.

## ELECTION OF OFFICERS

At a meeting of the Board of Trustees of the Academy held March 17, 1941, the following officers were elected:

*President:* Charles M. B. Cadwalader

*Managing Director:* Charles M. B. Cadwalader

*Vice President:* Edwin G. Conklin

*Vice President:* Rodolphe Meyer de Schauensee

*Treasurer:* Arthur E. Newbold, Jr.

*Assistant Treasurer:* John E. Bowers

*Secretary:* John E. Bowers

*Corresponding Secretary:* James A. G. Rehn





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## ERRATA

- Page 107, in title, for **ZIPHOID**, read **ZIPHIOD**.  
Page 109, line 24 for Ziphoid, read Ziphioid.  
Page 115, line 6, for Ziphoid, read Ziphioid.  
Page 118, subhead, for **ZIPHOID**, read **ZIPHIOD**.  
Page 171, under **SEMAPROCHILODUS** new genus, for TYPE.—*Prochilodus squamilentus* new species, read TYPE.—*Semaprochilodus squamilentus* new species.  
Page 183, for *Odontostile iheringi* new species, read *Odontostilbe iheringi* new species.





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